Meade Instruments Autostar Suite™

Computer Aided Astronomy
For Windows™

Version 5.50
4 March 2009

LIMITED WARRANTY

LIMITED WARRANTY. Meade Instruments warrants that (a) the SOFTWARE will perform substantially in accordance with the accompanying written materials for a period of ninety (90) days from the date of receipt, and (b) any hardware accompanying the SOFTWARE will be free from defects in materials and workmanship under normal use and service for a period of one (1) year from the date of receipt. Any implied warranties on the SOFTWARE and hardware are limited to ninety (90) days and one (1) year respectively. Some states/countries do not allow limitations on duration of an implied warranty, so the above limitation may not apply to you.

CUSTOMER REMEDIES. Meade Instruments and its suppliers' entire liability and your exclusive remedy shall be, at Farpoint's option, either (a) return of the price paid, or (b) repair or replacement of the SOFTWARE or hardware that does not meet Farpoint's Limited Warranty and which is returned to Meade Instruments with a copy of your receipt. This Limited Warranty is void if failure of the SOFTWARE or hardware has resulted from accident, abuse, or misapplication. Any replacement SOFTWARE or hardware will be warranted for the remainder of the original warranty period or thirty (30) days, whichever is longer. **Outside of the United States, these remedies are not available without proof of purchase from an authorized non-U.S. source.**

NO OTHER WARRANTIES. Meade Instruments and its suppliers disclaim all other warranties, either expressed or implied, including, but not limited to, implied warranties of merchantability and fitness for a particular purpose, with regard to the SOFTWARE, the accompanying written materials, and any accompanying hardware. This limited warranty gives you specific legal rights. You may have other rights which vary from state/country to state/country.

NO LIABILITY FOR CONSEQUENTIAL DAMAGES. In no event shall Meade Instruments, or its suppliers, be liable for any damages whatsoever (including without limitation, damages for loss of business profits, business interruption, loss of business information, or any other pecuniary loss) arising out of the use of, or inability to use, the Farpoint product, even if Meade Instruments has been advised of the possibility of such damages. Because some states/countries do not allow the exclusion or limitation of liability for consequential or incidental damages, the above limitation may not apply to you.

U.S. GOVERNMENT RESTRICTED RIGHTS

The SOFTWARE and documentation are provided with RESTRICTED RIGHTS. Use, duplication, or disclosure by the Government is subject to restriction as set forth in subparagraph (c)(1)(ii) of The Rights in Technical Data and Computer Software clause at DFARS 252.227-7013 or subparagraphs (c)(1) and (2) of the Commercial Computer Software--Restricted Rights at 48 CFR 52.227-19, as applicable. Manufacturer is Meade Instruments, 10932 Hasty Avenue, Downey, California 90241-4026

Table of Contents

Introduction

Welcome to Autostar Suite, the Desktop Observatory. Now you can perform many of the same computer assisted observing tasks as professional astronomer would do on a large institutional observatories. With Autostar Suite you can:

- View the sky as it appears from anywhere on Earth.
- See over 45,000 stars in their B-V colors.
- View scaled representations of over 13,000 clusters, nebulas, galaxies and other deep sky objects.
- Accurately display and animate all of the planets, 16000 asteroids and 650 comets.
- Using the high precision option, determine the position of the solar system object to an accuracy better than 1 second of arc.
- Zoom-in to a field-of-view less than 1 second of arc.
- Measure angular distance between stellar objects.
- Enhance high resolution CCD images using advanced image processing techniques.
- Determine stellar magnitudes directly from CCD images, and a number of other powerful features.
- Control your telescope and DSI or LPI imager with your computer either from a direct connection, or remotely via a network.
- Monitor your telescope's position on your computer as you observe
- Control Pictor, DSI, and LPI solid state astronomical imagers.
- Analyze your observations
- Process image in color or black and white.

A Note on Accuracy

Autostar Suite was designed to be extremely powerful and accurate. Many programs designed for the PC have taken shortcuts to appear faster, but at the expense of accuracy! Not Autostar Suite! By carefully coding each section of the program using 64 bit floating point numbers, Autostar Suite takes full advantage of your Math Coprocessor to provide fast and accurate performance. This gives you the power and accuracy that rivals main-frame computer performance.

The high precision does come with some cost in performance. Even though great care was taken to provide the most efficient code possible, Autostar Suite may be slower at certain functions, such as starmap generation, than programs that calculate positions only to a precision barely suitable for display purposes.

All calculations are performed using the most rigorous forms of the algorithms. The resulting values are comparable to those found in the *Astronomical Almanac*. Any resulting discrepancies are a result of the original values of the input data, not from programming short cuts. For example, the positions of the asteroids and comets, are first calculated to a high level of accuracy using Newton's method to solve Kepler's equation for the solution of an elliptical orbit. Then the coordinates are corrected for the time it takes for the light from the object to reach the Earth and for planetary aberration. This assures that the resulting values are correct for that exact instant of time. Finally, the coordinates are corrected for the precession and nutation of the Earth. If you have chosen the **Topocentric** precision option, the values are then corrected to show the position from your selected viewing site's latitude, longitude and elevation. Many other programs only use approximate formulae which may be valid only for a small time span.

System Requirements

The minimum system required to run Autostar Suite are as follows:

- 256 Meg Ram.
- Hard Disk with 500 Megabytes of free space.
- Super VGA adapter and compatible monitor.
- Windows 98SE or greater
- 200 MHz Pentium PC or faster.
- A Microsoft compatible mouse.

1. Installation

Insert the Setup disk into the CDROM drive. Normally, after a moment or two the following display will appear on the your monitor:

To install the entire Autostar Suite, simply move the cursor over the "Install Autostar Suite" button and click the left mouse button. You will prompted through the balance of the installation. In addition to the Autostar Suite, the CD-ROM also contains this manual and manuals for the Autostar Image Processing module and the DSI, DSI Pro, DSI II Pro, LPI, Pictor 416XT and 1616XT cameras. To view manuals, click on the "Manuals Screen". To view the Meade product catalog, click on the "Meade General Catalog" button. To install a USB driver for the RCX400 and MAX family of telescopes, click on "USB Drivers". Finally, to access Meade's website for the latest updates and product information, click anywhere on the Meade logo.

If the window above does not automatically appear after a few seconds, you can select the Run option from the Program Manager window. Then type:

D:SETUP then press Enter.

Where "D:" is the drive letter for your CDROM reader. The Setup program will prompt you for the desired drive and path in which to install the program and data files. Use may also choose the star database that you would like to install. Then it will begin uncompressing the files from the distribution disks and copying them to the appropriate locations on the Hard disk. Make sure you have at least 12 Megabytes of free space on the destination drive if you have selected the magnitude 8.0 star database and approximately 5 Megabytes if your using the magnitude 6.0 data.

If you change your mind and would like to install a different database option, just run the Setup program again, but select only those features that you would like to change.

Once the installation is complete, Autostar Suite will be ready to help you begin your own exploration of the Cosmos.

Quick Start

To get a quick overview of some of Autostar Suite features, follow the steps below:

To Set Location:

1. Select the Time menu, by clicking on the name or typing **Alt+T**.

2. Then select the Set Location entry. The **Set Location** Dialog Box will now be displayed.

3. Select either **Cities** or **Observatories**, then select your desired location.

4. Check the Timezone and Daylight Savings status by clicking on the **Set Timezone** button. The **Set Timezone** dialog box will be displayed.

5. Click on the **OK** button in the **Set Timezone** dialog box to return to the **Set Location** dialog box.

6. If you are satisfied with your selection, click on the **OK** box. Otherwise, make another selection, then click the **OK** button.

7. If you want to save these selections for the next session, select the **Save Parameters** from the **Time** menu.

To View the Starmap:

1. Select **Zoom** from the Starmap menu.

2. Choose **50%** coverage, if it is not already selected. This will give you a view of approximately 50% of the sky when looking straight up. You may also enter the Field of View directly in degrees if you desire. Click the **OK** button when finished.

3. Choose **Viewpoint** from the Starmap menu. Click on **South**. This will allow the Starmap to display the sky as it appears at the selected location looking southward *at this exact instant!*

4. Choose the **Options** menu item. This displays a selection menu of all of the Starmap options such as grid lines and names. Select the **Deepsky Objects** check box, then click on **OK**. The Starmap will now be displayed with Clusters (yellow circles), Nebulas (green squares) and Galaxies (red ellipses). If you zoom-in for a closer look at these objects, you will notice that they are drawn to scale. Each class of object has its own minimum size so that they will still be visible with a wide field of view.

5. Move the mouse so that the cursor is directly over a Star. Click the **Left** mouse button. You should now have the **Starmap Utilities** dialog box displayed and a bullseye is drawn around the object that you have selected.

6. Choose the **Get Description** radio button. If your aim was good, the **Object Description** dialog box will be displayed. Here you will find information such as the objects actual location, magnitude, B-V color, and a number of other features. Click on **OK** when you're done.

7. Open the **Object Selection** dialog box from the **Starmap** menu.

8. Select the **Messier** catalog and enter **51** (do NOT enter the M prefix) in the **Number** field. This will select M51, The Whirlpool Galaxy. Then click on the **OK** button. The starmap will redraw with M51 at the center of the display.

9. Open the **Zoom Factor** dialog box by selecting the **Zoom** entry from the **Starmap** menu or by holding down the control key and pressing "Z".

10. Set the **Field of View** to **0.5** degrees, then click the **OK** button. This will redraw the starmap showing both M51 and its companion galaxy. You may hit the **ESC** key to abort the drawing of each phase of the starmap.

11. To see an image of M51, just click on M51 and when the Star Map Utilities Box appears, click on **Show Image.** After a moment an image of M51 will be displayed in a new window.

16. Close the image display by clicking on the "x" icon in the upper right corner of the image window, or by choosing the **Close** function from the **File** menu.

By now you should have a good feel for the overall structure and methods used in Autostar Suite. You can now begin your journey into discovering the Cosmos!

2. File

The file menu contains a number of commands for opening and closing image files, printing images and selecting and maintaining the various databases used by Autostar Suite.

Open

The Open command allows you open either images or spectrographs in any of the following formats.

TIFF	- Tagged Image File Format (8 or 16 bit grayscale)
FITS	- Flexible Information Transport System (8bit, 16bit, 32bit and floating point grayscale)
BMP	- Windows Bitmap Format (8 bit grayscale/256 color)
PDS	- NASA's Planetary Data Systems Files
LNX	- Spectra Source Lynxx format (12 bit grayscale)
ST6	- Santa Barbara Instrument Group (16 bit grayscale)
ST4	- Santa Barbara Instrument Group (8 bit grayscale)
08B	- Raw (8 bit grayscale). Similar to ST4.

Images may only be viewed with the skymap module. To edit and save images, use the Autostar Suite Image Processing module described later in this document

To open a file:

- Select the desired format.
- Select the directory and filename from the list boxes
                              OR
- Enter the desired filename in the Edit box.

If the filename is specified without an extension, a default extension will be automatically added to the filename to reflect the current format. If the extension is provided, it will over-ride the current selection

The file will be loaded into two separate memory buffers, namely the display buffer and buffer A. The display buffer contains the image that is currently displayed on the screen, while buffer A is used as the source for the image processing functions. When an image processing function begins it copies the current display buffer into buffer A.

If the image file is part of an RGB composite image (red, green or blue), you may choose which RGB buffer to use as the destination. If you have selected either the Red, Green or Blue buffer, the buffer will be created, and the image will be copied into the buffer automatically. You may also copy the current image into the RGB buffers at a later time by using the **Copy Image** command.

Autostar suite is supplied with a set of reference images of the most popular deep sky objects and all the planets. When you initially use the open command, you will see the names of all the available images. You can add your own images to this library to customize Autostar Suite to fit your needs.

8 Bit versus 12 bit, 16 Bit or Floating Point Images

When 12 or 16 bit images are loaded, they must first be compressed down to 8 bits (256 gray levels), which is the maximum number of simultaneous colors that Windows can display at one time. To prevent the loss of important data, Autostar Suite automatically senses the larger data format and displays the **Image Prescale** dialog box, which allows either automatic or manual setting of the parameters used to compress the data into an 8 bit format. This dialog box displays the histogram of the 16 bit data in a large graph at the top and, at the bottom, a smaller graph of the resulting data after compression.
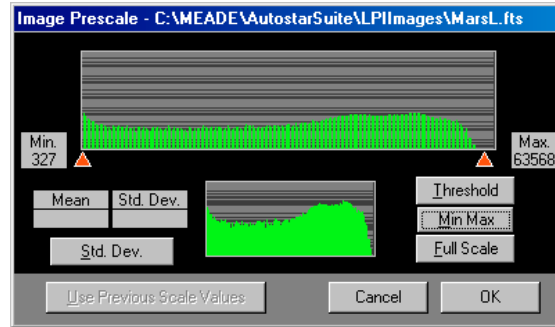
After the image is loaded in 16 bit format, a histogram is constructed that shows the distribution of the data contained in the image. Normally the data is distributed in a rather narrow range of values which lends itself to scaling to the 8 bit format. Once the histogram is constructed, the Threshold values of the data is calculated and are used to set the scaling range. This gives a reasonable starting point for scaling most images. The threshold values may be reset at any time by pressing the **Threshold** button.

Since the data is not evenly distributed, some fine-tuning of the limits is usually needed. This is accomplished by using one of the predefined scaling options or by moving the red markers located under the main histogram display. Generally, the best images are obtained with the markers set just at the high and low edges of the important data. Values that are above the upper marker result in pure white pixels, while those below result in pure black.

If the **Std. Dev.** button is depressed the Mean and Standard Deviation of the image are calculated. The upper limit is set to the Mean plus 5 Standard Deviations, while the lower limit is set to the Mean minus 1 Standard Deviation.

The **Min Max** button sets the pointers to the extreme minimum and maximum values contained in the image, while **Full Scale** sets the values to 0 and 65535 which are the minimum and maximum values possible in a 16 bit image.

If you are loading images from an RGB composite set of files, you may find it useful to use the same scaling values for each of the individual images. This is easily accomplished by using the **Use Previous Scale Values** button located at the bottom the the dialog box. Since many astromonical images contain a large amount of red light, you may want to load the red image first, scale it properly, then use the same scaling values for both the green and blue images.

Close

Selecting Close will close the current file and remove its display window and any support windows, such as the Histogram.

Save Map

Selecting Save Map allows you to save a copy of the current starmap as a BMP image. This command is useful for exporting sky map views in papers, documents, presentations and web pages. When selected this command displays the Save Map dialog box and allows saving the current image.

To save the starmap

     - Select the directory and filename from the list boxes
               OR
     - Enter the desired filename in the Edit box.

If the filename is specified without an extension, a default ".BMP" extension will be automatically added to the filename to reflect the current format. If the extension is provided, it will over-ride the default.

Load Map Settings

Selecting Load map Settings allows you to load previously saved starmap configurations. This way you can quickly recall fields of view, color schemes and line styles by name. Several different confiugation examples are shipped with the product.

Save Map Settings

The Save Map Settings allows you to save a starmap configurations on disk to be recalled later. When you select this command you will be prompted to enter the name for this configuration file and it will be written to disk. Later, you can quickly recall fields of view, color schemes and line styles by name.

Print

The **Print** command sends the current starmap to the print spooler for the current default printer. The starmap is scaled so that it completely fills the printing area of the paper in the horizontal direction. The vertical scale is then chosen to preserve the original aspect ratio of the star map. Additional information pertaining to the starmap is also printed at the bottom of the page, below the image.

Printer Setup

Displays the **Printer Setup** dialog box which allows the selection of any of the currently installed printers.
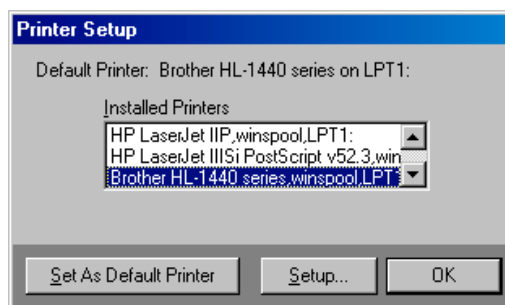
By selecting the **Setup** button, the Setup dialog box for the current printer is displayed. You can alter the settings for printer using its setup dialog. To make the highlighted printer the default printer, you must click on the "Set As Default Printer" button. If you do change the default printer, remember this may affect other applications run subsequently on your computer.

Page Setup

Displays the **Page Setup** dialog box which allows you to control headers, footers and margins that will be used in printing your star maps.
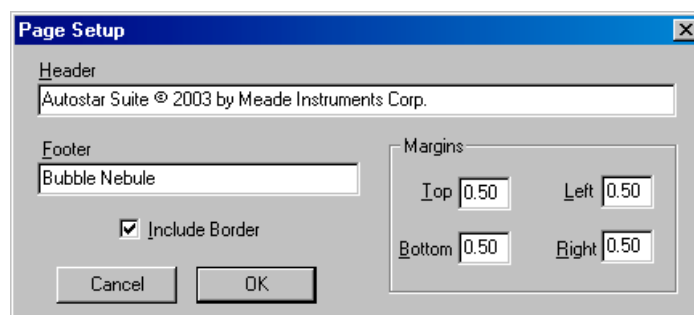
Set Custom Catalogs

The **Set Custom Catalogs** dialog box allows you to select the user data files to be used in drawing the star map. You can create unique data files for each of your different projects, or import any popular astronomical catalog and incorporate it into your star map displays.
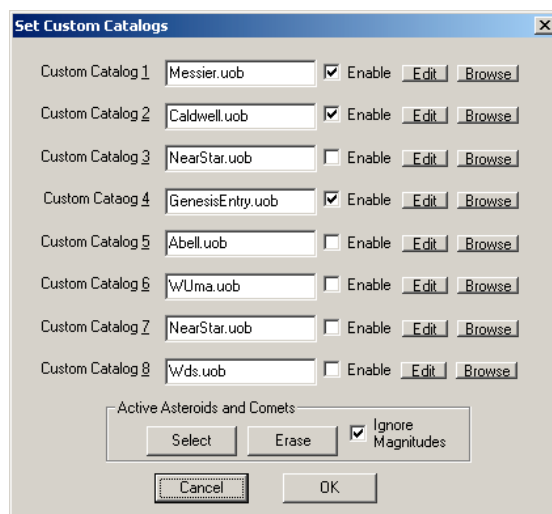
Autostar Suite allows up to 8 custom catalogs and one *Active Comet* catalog and one *Active Comet* catalog to be used in any starmap. To change or edit the custom catalog, you can simply type the name of the catalog or you can use the browse button to navigate ar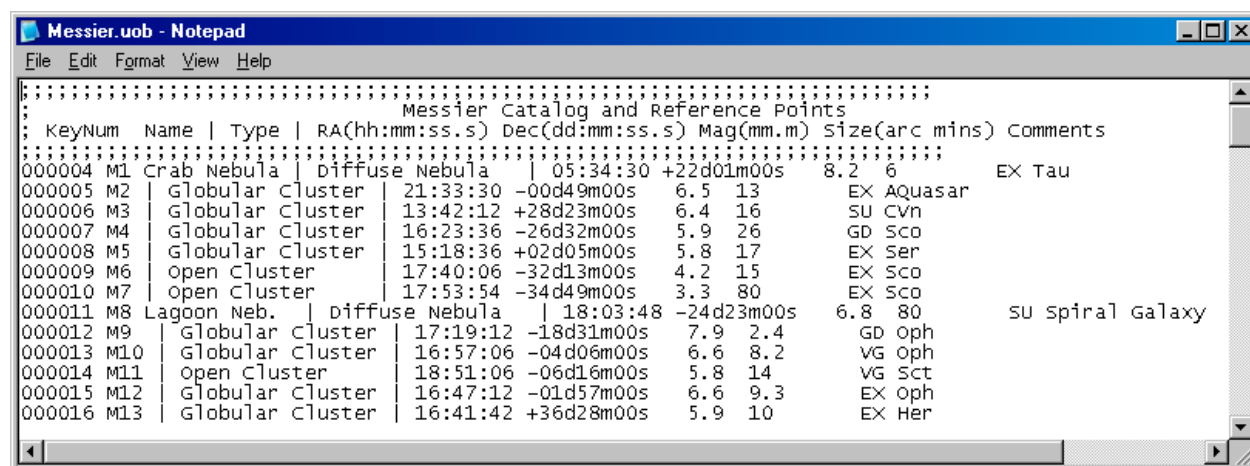ound your system to locate a desired catalog. Catalogs can be enabled or disabled by checking the box next to the catalog name.

Custom catalogs are simple ASCII text files with columns of data. To edit a catalog using Windows notpad or wordpad, just click on the **Edit** button. A window similar to the one shown below will open for you to edit your data.

A User Object File consists of a one line per entry table. Each entry contains a unique Key Number, Name, Object Type, R.A. (Right Ascension) , DEC. (Declination), Magnitude, Size and a comment. Each entry in the file must be contained on a single line terminated with a CR and LF to delimit the line. There is no limit to the number of objects that may be contained in these files. See the header at the beginning of the supplied user files, "*.UOB", for a description of the format of the files.

Active Asteroid and Comet catalogs can be managed by pressing the *Select* or *Erase* buttons. These allow you to control which asteroids and comets are display. When you hit the *Select* button the following dialog appears:
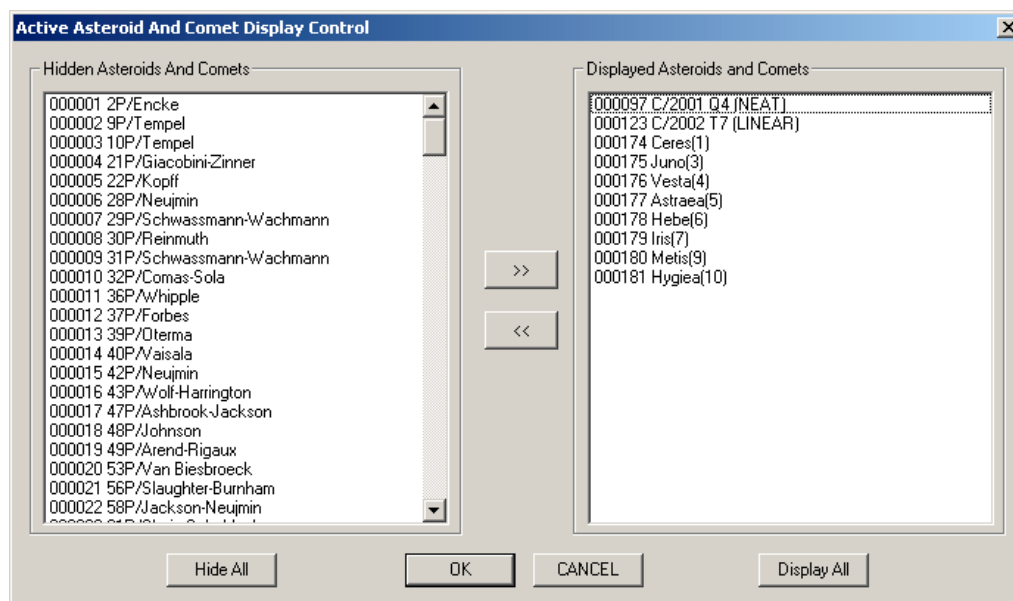
The comets and asteroids on the left are not display. Those in the right window will be displayed when they are brighter than the current display magnitude limits, or if the check box on **Ignore Magnitudes** has been checked. You may select individual or groups of minor planets and use the move buttons in the center of the display to move them between the windows.

Compile

Re-builds the binary versions of any of the following databases:

Stars	-	(STAR.DAT)
Deepsky Objects	-	(DEEPSKY.DAT)
Constellations	-	(CONSTELS.DAT}
Planets	-	(PLANETS.DAT)
Comets	-	(COMETS.DAT)
Asteroids	-	(ASTEROID.DAT)

Each of the above files are in a simple ASCII format, each line is delimited with a CR and LF character. You may modify these files to update any of the information for the particular class of objects. Each file begins with a brief description of the format of the data that follows. The length of each line must remain the same.

WARNING: The data contained in these files is copyrighted. You may not distribute this data in any form, EVEN if you have modified it. Modifying any of the data may corrupt the integrity of the database. You may consider adding new objects to the database, but, DO NOT modify the existing values unless you are sure that the new values are correct!.

Build Tables

Re-builds the files used for the Right Ascension and Declination crosses or circles. This is useful only if the data files have been corrupted.

Setup Status Bar

This menu item allows you to configure what information will be displayed on the status bar when it is displayed. Selecting this command presents the following dialog:
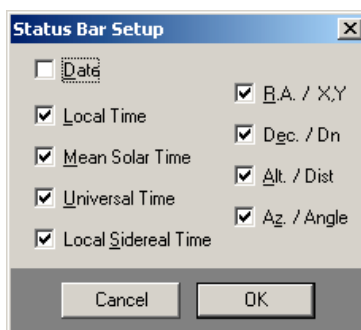
The items in the right hand column, are all linked to the cursor. As the cursor is moved over the display, the Right Ascension, Declination , Altitude, Azimuth of at the cursor is displayed.

Exit

Shuts down Autostar Suite in an orderly fashion and returns to the Windows Manager. If there are any modified files opened, you will be prompted to save those files.

3. Time

The **Time** functions allow you to set the time and date, display the current time in a variety of formats, and select the location from which you want to observe. You may select a time and date anywhere from January 1, 4713 B.C. to December 31, 9999 A.D.. However, you would normally select dates that correspond to your planned observing sessions.

If you set a date or time, Autostar Suite's internal clock is halted and all calculations will use your chosen time and date. If you choose to use the system time, the internal clock will again begin running and will be accessed in real-time as the system requires.

When Autostar Suite is communicating directly with an observatory, the observatory will provide an accurate time source for Universal Time (UT1). When not connected, Universal Time is derived from the internal clock of the PC.

Time Display

The **Time Display** function displays a modeless dialog box that allows you to continuously monitor all of the current times required by Autostar Suite. Since the **Time Display** is modeless, you may keep the display active while using other program functions. The display can be disabled either by selecting the **Time Display** menu item, or by double clicking the **left** mouse button on the symbol in the upper right corner of the display.
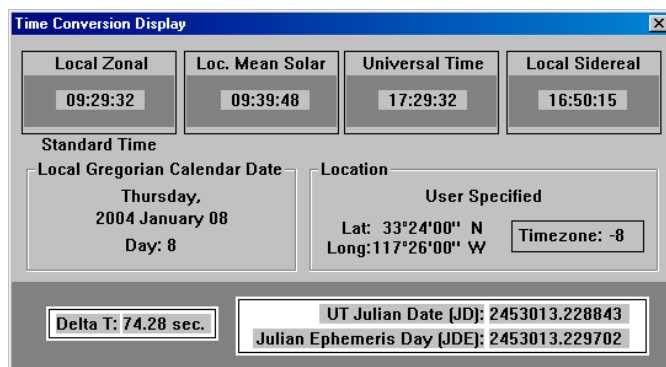
The first time display is that of the **Local Zonal Time** for the currently selected location. If Autostar Suite is not connected to an observatory, this value is derived from the internal clock of the PC. The current status of daylight savings time is shown below the Local Solar display.

The **Local Mean Solar Time** is the actual local time based on the mean position of the sun. This time, plus the value of the Equation of Time yields **Local Apparent Solar Time**, which is the time indicated by a sundial at the current location.

The **Universal Time** display shows the value of the time at Greenwich, England. This is the precise time used in all astronomical calculations. The time returned from an observatory will be its current value of Coordinated Universal Time (UTC) corrected for its position. The corrected time is then called UT1. Observatories near the United States will probably be using (UTC) derived from radio station WWV or WWVH (Hawaii).

If the Universal Time value reflects a time that is on a day different from the current local day, a warning is displayed below the display indicating that fact. The message **Next Day** will be displayed if the UT day is greater than the current day, and **Previous Day** if it is less. No message will be displayed if the UT and local days are the same.

Finally, the **Local Sidereal Time** is shown. This is the Local Apparent Sidereal Time for the current location. Sidereal time is the Right Ascension of any object that is directly overhead (Zenith) at that instance. Or to look at it another way, Sidereal Time is the time that has elapsed since the Vernal Equinox (or first point of Aries) has passed overhead. The sidereal time must always be known when attempting to locate objects in the sky based only on their given coordinates.

Below the time displays, the current Gregorian date is shown along with the current location and its coordinates. These are shown merely for reference.

The **Delta T** value is displayed for reference. This value is used when converting from Universal time (UT) to Barycentric Dynamical Time (TDB). If you have set the current time and selected the **Set Dynamical Time** option, this value will be zero (0.0), otherwise it displays the number of seconds added to UT to produce TDB.

The final values displayed are the **Julian Date (JD)** and the **Julian Ephemeris Day (JDE)**. The Julian date is the number of days, and fractional days, since January 1, 4713 B.C., at 12:00 Universal Time. The Julian date is the current date on the Prime Meridian which runs through Greenwich, England and is therefore a function of the Universal Time (UT1). JDE is the Julian date corrected by Delta T. This value is used in all of the Ephemeris and Sidereal calculations.

Set Time & Date

Setting the current time and date can be accomplished in two different manners. You may enter either the standard (Gregorian) time and date values or you may enter the full Julian date. Either method is equally valid. Once you specify a time and date, the internal Autostar Suite clock is frozen at your desired settings. The internal clock runs only when you are using the system clock (either from the PC or the observatory). To start the system clock, select either **Gregorian** or **Julian** from the **Set Time & Date** menu and push the **Use System Time & Date** button.

The entered value may also be used as the current Dynamical Time by selecting the **Set As Dynamical Time** button.

Gregorian

The Gregorian time and date format is the format that is normally used throughout the world. It was established at noon on October 4, 1582 by Pope Gregory. At that instance of time, the current Julian date was 2299160.0. The very next instance became October 15, 1582 and the Julian date became 2299160.5. This was done to correct for errors that had accumulated, since the previous calendar did not include leap years. Pope Gregory's new calendar included an extra day every four years. This is the calendar we still use today.

Julian

The Julian calendar is merely a sequential count of the number of days since 1 January, 4713 B.C. (which is written 1 January, -4712). This value is useful when calculating the Ephemeris data (the changing positions of the planets, comets, etc.). Most technical almanacs, such as the *Astronomical Almanac,* exclusively use the Julian date when specifying a particular time and date.
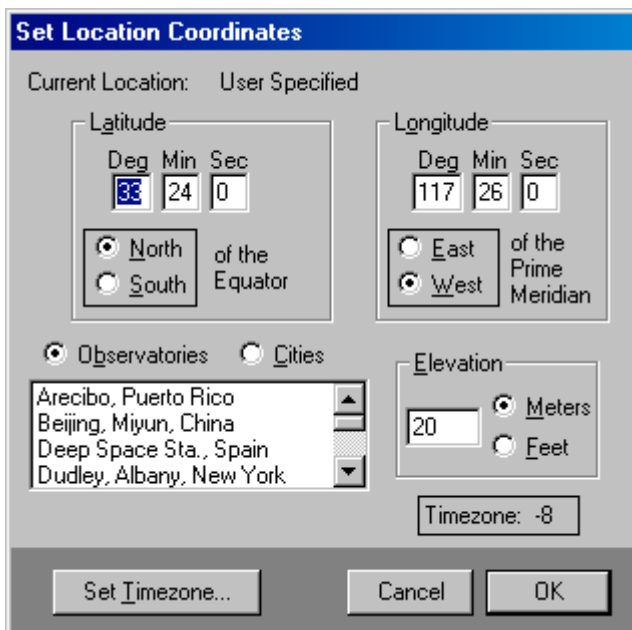
Set Timezone

The **Set Timezone** function allows you to change the value for the timezone of the current location. The Daylight Savings feature can also be enabled or disabled from this dialog box. You should always set the timezone value correctly, then select Daylight Savings as appropriate.

Set Location

Selecting the **Set Location** menu item displays a dialog box which allows you to pick an Observatory or City location from which you will be observing. You may either choose from a list of predefined locations or you may enter your own latitude and longitude coordinates. If you enter your own coordinates (or modify predefined values) the Time Display will show *User Specified Location* instead of the actual location name. This assures that only the predefined (and correct) coordinates are used if you are sending requests to an actual observatory.

If you have entered your own coordinates or wish to change the status of Daylight Savings, you can access the Set Timezone dialog box directly by pushing the **Set Timezone** button.

Autostar Suite 17

Save Parameters

Selecting the **Save Parameters** item from the **Time** menu allows to save the location, coordinates and timezone information in the AutostarSuite.INI file. This file is located in your current Windows directory. This file contains information so that the next time you run Autostar Suite, it will begin with your desired values.

Note: Other Autostar Suite information is automatically added to the AutostarSuite.INI file as the program runs. The Save Parameters function only saves the location parameters, which are NOT saved by default.

4. Ephemeris

The **Ephemeris** menu allows you to view the parameters of the ephemeral (changeable) objects in the Solar system. The detailed parameters of each object can be viewed individually by selecting the object directly from the menu.

The values shown are a function of Autostar Suite's current time value and the precision that is set in the **Starmap** menu. All values are calculated using the accepted rigorous methods. For the most accurate geocentric (Earth centered) values, choose the High precision mode. By selecting the **Topocentric** precision mode, you will see the high precision values that are also corrected for the current location and elevation.

NOTE: The accuracy of the minor planet database decreases as the time from the 'Epoch of Osculation' increases. Autostar Suite is shipped with the most current data available at the time of packaging, but due to variations in the supply of the product, you may receive data that is somewhat outdated. For normal applications the values are acceptable for several years, but for extreme accuracy, the data may only suffice for several weeks or months. For highly accurate applications contact Meade Instruments to obtain an updated database. Normally, the new data is published every six months.

Library Asteroids And Comets

Recent advances in robotic telescopes and computer image scanning have allowed us to discover over 100,000 objects orbiting the Sun. Autostar Suite contains a subset of 16,000 of these asteroids and comets. These are revered to as the **Library Asteroids** and **Library Comets.** Displaying all of these objects, and re-computing their positions to Autostar Suite's high level of accuracy can take a long time, even on a fast machine. To allow you to better mange the display of object, the program keeps sub-catalogs call **Active Asteroids** and **Active Comets**. The menu selections in Ephemeris help you manage the Active catalogs, or look at the position of individual objects.

When you select **Library Asteroids/Named,** the dialog below appears:
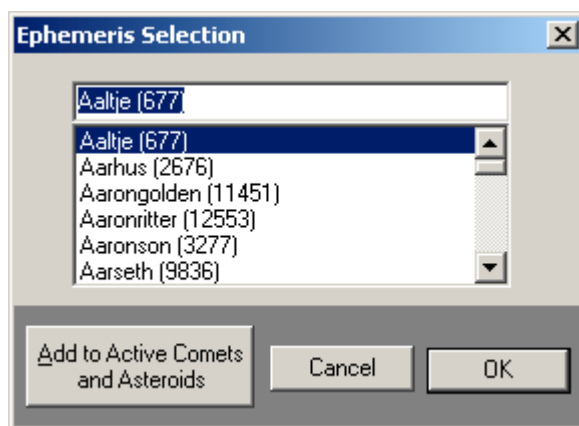
This dialog lets you select an individual asteroid. The **Add to Active Asteroids** button causes the asteroid to be copied to the *Active Catalog*. If you select an asteroid, a position dialog is displayed. This dialog shows the current position of the object and offers the opportunity to center the star map on the object and to print out a position table showing object positions verses time.

Import Asteroids
Import Comets

Because comets and asteroids are small bodies, their orbits are constantly being perturbed by larger planets, solar winds, and out gassing. Because of these phenomena, their orbits need change over time. To allow you to update your comets and asteroids, you can import new elements for these from Meade's website. Autostar Suite and Autostar telescopes share a common catalog format. Updating you elements is as easy as click on the Import menu item. After you have selected the menu item, the following dialog appears:

You have the choice of replacing all of your current entries, or appending new data to your catalog. Once you have made this selection, a file selection dialog box will appear and you should select the orbital element files you have download from The Web.

Moon Calendar

The **Moon Calendar** command displays the phases of the moon in a convenient calendar format. By default the current mouth is displayed. To look at other months, you can use the **Month** and **Year** controls at the bottom of the display. The calendar can also be printed on the default printer by selecting **Print.** When you are finished, select **Done**, to dismiss the dialog.
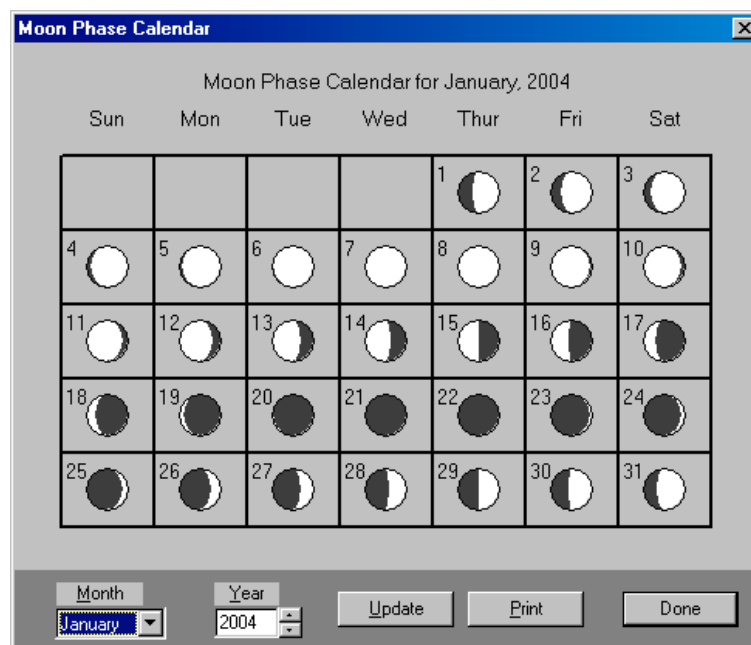
Eclipse Calendars

The **Eclipse Calendars** command displays a world map of upcoming total and partial solar eclipsed. The map shows the path of the eclipse across the Earth and the date when the eclipse will occur.

Show Current Values

The **Show Current Values** command displays the current values of the variables used in all of the Ephemeredes. Occasionally, you may want to calculate your own ephemeris, instead of deriving all of these values, you can simply set the time and date to your requirements, then use these values.

All values used by Autostar Suite are derived by the rigorous methods as outlined in the *Astronomical Almanac* or in Jean Meeus's book *Astronomical Algorithms* (see the bibliography). This assures exceedingly accurate and precise results. These values displayed here are always shown to their full precision, independent of the setting of the Starmap Precision.

5. Starmap

Autostar Suite provides a highly detailed and extremely accurate map of the sky that includes stars, planets, galaxies, nebulas and other deep sky objects. The map has a number of selectable options that allow you to generate the map in a way that best suits your needs. Once you have configured the starmap to your requirements, you can generate a high quality hard copy version.

You can center the starmap on any star, deep sky object, or constellation you choose. Or you can set the center coordinates to any Right Ascension and Declination values you desire.

The starmap is normally drawn as a spherical projection. That is, each object's position is calculated based on the current Zenith viewpoint and is then mapped, or projected, onto a sphere. This results in a display that has the minimal amount of distortion around the point of interest, but, it is more computationally expensive than the flat polar or equatorial projections that are sometimes used.

All starmap plotting functions are implemented using 64 bit floating point numbers with 80 bit intermediate results. This provides extremely accurate maps, even when the field of view is less than 0.00001 degree.

Previous View

Redraws the starmap using the previous field of view and Zenith coordinates. This is used as an 'Undo' function.

Redraw

Redraws the starmap. Occasionally, other windows drawn over the starmap may corrupt a portion of the map, or leave some remnants over the starmap image. The **Redraw** function clears the map and renders a new map using all of the current parameters.

Animate Starmap

The **Animate Starmap** command allows you to redraw the ephemeral objects (Planets, Comets and Asteroids) in rapid succession while incrementing the date and time between each redraw. A trail is left behind the object as it moves.

To begin animation, first select the **Step Time** and the units, either days, hours, minutes or seconds, then press the **Start** button. The starmap will begin updating the positions of all the ephemeral objects that were selected in the **Options** dialog box. While the animation is running you may change the step time or the units, or change the direction. Pressing the **Stop** button halts the animation, leaving the trails displayed on the screen. You may click on any of the trails to determine which object produced the trail. Note that the position that will be displayed in **Object Description** dialog box will show the coordinates of the object at the current date and time, NOT the date and time of the position in the trail.
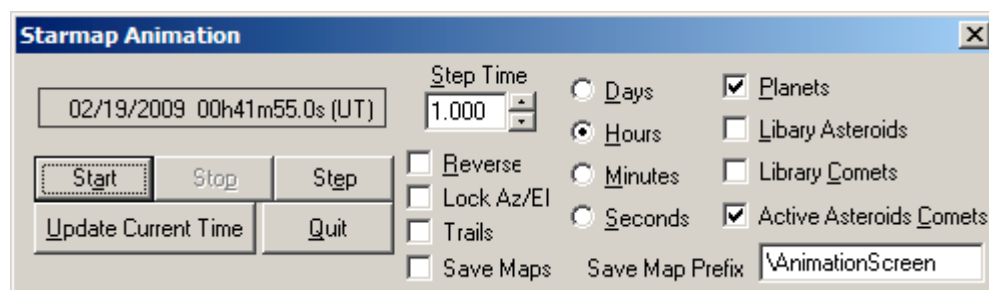
The **Reverse** option allows you to clear the display, draw the objects in their normal starting positions, then begin animation from the last position calculated. This is useful when looking for conjunctions or occultations.

In addition to the **Reverse** switch, two switches are provided to change the way the animation is handled. The **Lock Az/El** changes the animation so that the current Azimuth and Elevation of the viewpoint is locked to the center of the display. This method dramatically displays the apparent motion of stars against the sky. The **Trails** switch, keeps the previous display from being cleared before the next is drawn. This is a great switch to use to plot the retrograde motion of plates, or to chart occultations and transits.

Finally, you can save each successively generated Skymap image as a BMP file. The files can be used to create video and GIF animations showing how objects, or the sky move. To generate such a series of BMP file, check the **Save Maps** box. The files will be saved in the directory noted to the right of the text box.

You may also set the Autostar Suite time value to the time of the current animation step. This allows you to 'freeze' the time of an event such as on occultation. At anytime during the animation you may click on the **Update Current Time** button. This will copy the displayed time value from the Animation dialog box into the system time value, just as though you had entered the time directly from the **Set Time & Date** function.

Viewpoint

The **Viewpoint** command allows you change the position in the sky, and in some cases the scale and orientation of the Starmap display. When you select the **Viewpoint** command, you well get a sub-menu with additional commands. The **North, South, East, West** and **Zenith** commands will change the set the viewpoint of the Starmap so that it will appear as seen by an ground based observer looking in the indicated direction. The Starmap will be rotate so that zenith is towards the top of the display and the Starmap scale will be set to a 90 degrees apparent field of view.

If you select the **Custom View** command, a dialog box allows you to set the current R.A. and Dec. values for the center of the Starmap display. Once you have set the R.A. and DEC. fields, selecting **OK** will redraw the star map with the requested position at the center of the display.

If you already know the coordinates of the object, merely enter the Right Ascension in hours, minutes and seconds, and the Declination in degrees, minutes and seconds, then select the OK button. The Starmap will be redrawn with your coordinates at the center of the screen.

If you select the **Goto Current Zenith** command, the R.A. and DEC. of the current zenith position at your location is copied into the R.A. and DEC fields.

If you are currently connected to and LX200 or Autostar telescope, the **Goto Telescope Coordinates** button will copy the telescopes current position into the R.A and DEC. fields.

To maintain a consistent point of reference of celestial objects, a fixed reference frame must be established. Currently there are two different reference systems in use: the Julian reference (FK5) and the Besselian reference (FK4). The Julian system is based on a year that is *exactly* 365.25 days in length. The Besselian system is based on the tropical year, which varies from year to year. In 1984, the International Astronomical Union adopted the Julian system and established that the new standard reference (Epoch) will be called J2000.0. J2000.0 begins on 2000 January 1, at 12:00 noon Dynamical Time (TD).

To allow you to input coordinates from another epoch, such as B1950.0, that epoch value must be entered into the **Epoch** field. To select the Besselian reference frame (FK4) select the **FK4** (Fundamental Katalog 4) button, the Epoch field will then be set to B1950.0. You may change the epoch year value, but the Besselian reference will be used instead of the Julian reference. Selecting the **FK5** (Fundamental Katalog 5) button sets the Epoch to J2000.0. Again, you can change the year value, but the Julian reference will remain.

If you are entering star coordinates from a catalog other than one referenced to J2000.0, you should enter the appropriate reference frame, FK4 or FK5 and set the catalog's epoch value. You should also enter the star's proper motion in both R.A. and Dec. to accurately locate the star.

When the OK button is selected, all of the entered values will automatically be transformed from FK4 to FK5 if needed, then star's proper motion will be applied, then the coordinates will be precessed from the epoch year to J2000.0 . If you redisplay the **Custom Viewpoint** dialog box, you will see the epoch value reset to J2000.0 and the coordinates will now show their corrected J2000.0 positions.

Object Selection

Displays the **Object Selection** dialog box. The Object Selection feature allows you to select an object from one of Autostar Suite's catalogs or from one of the object databases. There are four major catalogs:

1) Messier
2) NGC (New General Catalog)
3) IC (Index Catalog of Nebula)
4) SAO (Smithsonian Astrophysical Observatory)
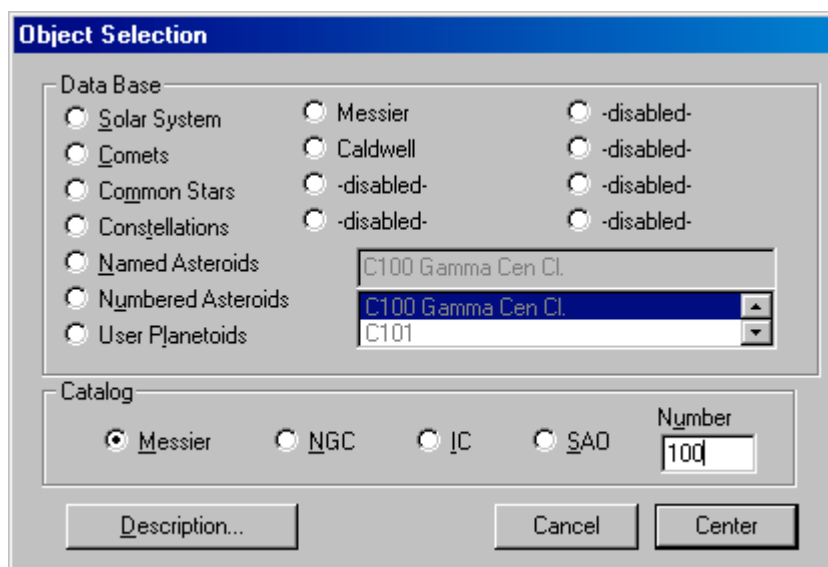
The Messier catalog was originated by Charles Messier (1730-1817) as objects *"to be avoided while seeking comets"*. It contains some of the best galaxies, clusters and nebulas. Messier objects are given names such as, M51 or M42. Many Messier objects are frequently called out by their NGC designations which sometimes leads to confusion. Autostar Suite translates Messier designations into NGC, with the exception of M24 and M45 (The Pleiades) which do not exist in either the NGC or IC catalogs.

The *New General Catalog of Nebulae and Clusters of Stars* was first compiled in 1888 by J.L.E Dreyer. This catalog has been updated since its original publication and two subsequent Index Catalogs were produced. Objects from the NGC catalog have names such as NGC 1984, while the Index Catalog objects use names such as IC 939.

The SAO star catalog contains position and other useful information on most of the known stars. It was compiled by the Smithsonian Astrophysical Observatory. The standard version of the catalog shipped with Autostar Suite contains all stars down to magnitude 8.0, over 45,000.

In addition to the major catalogs, there are also a number of object databases:
- Solar system
- Comets
- Common stars
- Constellations
- Named asteroids
- Numbered asteroids
- Custom Catalogs
- User planetoids

These databases allow you to select from a variety of objects. The Asteroid database is quite large and may cause a delay while loading all of the names.

Pushing the **Description** button displays the Object Description dialog box that show all of the parameters of the selected object. Pushing **Center** dismisses the dialog and redraws the Starmap with the requested object in the center of the display.

Lock Az/El

The **Lock Az/El** command, will toggle the Az/El Lock. When the Az/El lock is checked, the lock is enabled. Enabling the lock will keep the Starmap centered on the same Altitude and Azimuth, relative to a ground based observer as time passes. When not locked, the Starmap will stay centered on the same R.A and DEC. coordinates.

Zenith Up

The **Zenith Up** command, will toggle the orientation of the displayed Starmap. When the **Zenith Up** is checked, the the Starmap will be draw so that the local Zenith will be toward the top of the display. This is the orientation in which a ground based observer sees the sky, or as it appear through an Alt./Az. Mounted telescope. When uncheck, the Starmap will be drawn with the celestial pole towards the top of the display. This is orientation seen by observers looking though equatorially mounted telescoped.

Magnitudes

The **Magnitudes** dialog box allows you to set the range of object magnitudes that will be displayed by the Starmap. The default values are -5.0 for the brightest objects and 22.00 for the dimmest. All displayed objects are affected by these settings, with the exception of the Sun and Moon which are always shown if the Planets are enabled.
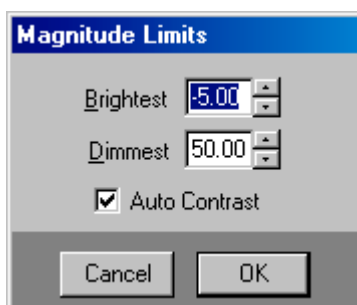
Many of the deeps ky objects do not have assigned magnitudes, Autostar Suite defaults these objects to magnitude 22.00 when they are being displayed.

Because the display can quickly become cluttered as you zoom out to a wider field, Autostar Suite offers the option of dynamically changing the Magnitude Limits for you. If you check the **Auto Contrast** switch, the program will

dynamically change the limits as you zoom in and out to keep a manageable number of objects displayed. This is the default setting for the program.
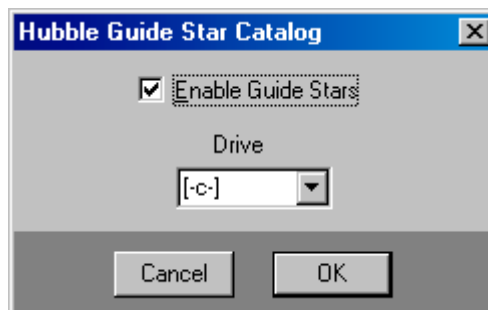
Hubble Stars

The Hubble Stars dialog allows you to enable and disable the display of stars from the Hubble Guide Star Catalog.

When enabled, Hubble stars are displayed when the field of view is smaller than 20 degrees. The Hubble catalog includes stars beyond Magnitude 16, so displays can become very dense and redrawing can slow down. Performance can be markedly improved by copying the GSC to your hard drive during installation. If you plan to use the GSC frequently, we recommend it be installed on your hard drive. For occasional use, the catalog can be read from your product CDROM.

Invert Screen Colors

The **Invert Screen Colors** command, toggles the display between normal white stars on a black field, to black stars on a white field. In the **Inverted Screen Colors** command is checked, the display will appear more like many printed star charts.

Mirror

The Starmap **Mirror** function flips the display in either the Horizontal or Vertical direction. This allows the map to be drawn to match the view that is seen through the telescope or as seen with a diagonal.

Zoom

The field of view shown by the starmap display is changed by the **Zoom** dialog box. The field of view may be entered in degrees , fractions of degrees, or by selecting one of the sky coverage buttons.

Since the size of the display window is variable, the map is scaled to include the selected field of view in the smaller of the x or y directions. If you desire a precise indication of the field of view of the telescope, select the **Telescope Fields** item from the **Options** dialog box.

Projections

The Starmap is normally drawn in a **Spherical** projection. That is, each point is calculated in X,Y, and Z then projected (mapped) onto a sphere. This projection produces a display that has minimal distortion at the center of the display, independent of the actual position of the object on the celestial sphere.

The spherical projection requires a substantial amount of processor time to generate a map, but the final results far outweigh the small increase in display time. Other simple projections are sometimes seen in other programs. These are used to increase the apparent rendering time of the map, but they introduce significant amounts of distortion. Autostar Suite uses only the most accurate display techniques.

A variant of the spherical projection is the **Azimuthal Equidistant** projection. This projection differs from the spherical in that the Z coordinates of the point are projected onto a flat plane, rather than onto a sphere. The resulting projection gives a more satisfactory display of the entire sky, especially near the horizon. However, the objects at the

center of the map are somewhat smaller than objects near the horizontal. Use this projection when trying to find constellations or to orient yourself with the sky, but use the Spherical projection when zooming into a smaller area of the sky.

The R.A., Dec. and Dist. values shown in the Coordinate Display are correct in either projection.

Precision

To increase the display speed of the planets, comets and asteroids, the **Precision** menu allows you to choose the precision that best suits your requirements. The lowest precision gives the fastest rendering time. If you are interested in animating the motions of the all of the objects, choose the **Low** precision mode. If you are animating only the comets or planets, the **Medium** mode will give positions that are very close to the actual positions, but will take slightly longer to calculate. Finally, if you desire precision comparable to the *Astronomical Almanac*, choose the **High** mode. This mode calculates values using the most rigorous forms of all the equations and corrections needed to accurately determine the objects position to sub-arc second accuracy.

For the most accurate **Geocentric** (Earth centered) values, select the **Geocentric** option then choose the **High** precision mode. By selecting the **Topocentric** precision mode, you will use the geocentric values that are also corrected for the current location and elevation. This will give the values that pertain precisely to your selected location and time.

The precision setting will be reflected in the displayed values in the Ephemeris tables, and in the resulting Right Ascension and Declination values shown in the Object Selection dialog box. *Make sure you have selected the correct precision and reference before comparing the positions with published values!*.

The three precision settings (Low, Medium and High) correspond to the three basic position references, **Geometric**, **Astrometric** and **Apparent**.

The **Geometric** position (Low precision) is calculated without any of the corrections for the effects of light time, aberration, etc.. Additionally, the Geometric parameters are calculated at a lower precision to increase the speed of the calculations.

The **Astrometric** position (Medium precision) is first calculated to the full precision (J2000.0) Geometric values, then the correction for light time is added. The Astrometric mode is used for comparing the positions of Pluto and the asteroids and comets with the position of the stars. The *Astronomical Almanac* shows the positions of Pluto and the minor planets in the Astrometric Geocentric mode.

The **Apparent** position (High precision) mode starts with the high precision Geometric values, then corrects for the light time effect, aberration, precession, nutation in obliquity and nutation in longitude. The positions are referenced to the Equinox and Equator of Date, not the standard reference of J2000.0. The *Astronomical Almanac* show the positions of the planets in the Apparent, Geocentric mode. For the current 'TRUE' positions of the objects use the Apparent, Topocentric mode.
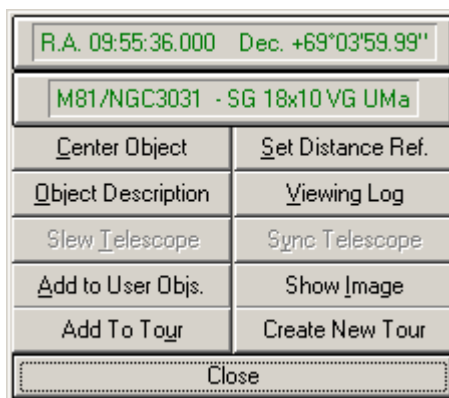
Reset Parameters

The **Reset Parameters** function sets all of the Starmap options, viewpoint, mirroring, and magnitude limits, to the initial default settings. This is useful when a large number of specialized options have been chosen and you want to start a new display session from a known starting point.

6. Starmap Utilities

The **Starmap Utilities** dialog box is displayed by clicking the left mouse button anywhere on the Starmap display. You would normally want to set the cursor over a particular object before clicking the button, but it is not required.

The top of the Starmap Utilities box displays the current coordinates of the mouse in (Right Ascension and Declination) at the time the button was pressed. Below the coordinate display is a number of radio buttons that allow you to select the available functions.

```
R.A. 09:55:36.000   Dec. +69°03'59.99"

M81/NGC3031  - SG 18x10 VG UMa

Center Object          Set Distance Ref.
Object Description     Viewing Log
Slew Telescope         Sync Telescope
Add to User Objs.      Show Image
Add To Tour            Create New Tour

                Close
```

Center Object

The **Center Object** feature resets the Zenith coordinates to the current mouse coordinates and re-draws the starmap. This allows you to quickly center the display on the area, or object, that you choose.

Set Distance Ref

The **Set Distance Reference** enables the distance measurement feature and locks its starting point to the current coordinates of the cursor. With distance measuring enabled, you will notice an additional field in the Coordinate display. The Dist. field shows the angular distance in degrees, minutes and seconds from the starting point to the current position of the cursor. As you move the cursor you will see a line drawn from the starting point to the current position of the cursor. Clicking the left mouse button disables the distance measurement feature.

Object Description

When **Object Description** attempts to find the object near the current mouse coordinates, and, if found, displays information describing the object. If there are a number of objects very close together, it is recommended that you first Zoom into the area so that you can accurately locate the object. If no object if found, a warning message is displayed.

Add to User Data

The **Add to User Data** function appends a new entry onto the currently selected User Object file using the R.A. and Dec. values displayed at the top of the dialog box. These values are the coordinates of the mouse when the dialog box was created, NOT the coordinates of the object that may be near this location.

After the **OK** utility box button is depressed, the current object file is opened for editing by the Windows Notepad program. You must then add an unique object ID and a description to the new entry which appears at the bottom of the list. The object ID should normally increment sequentially from the first entry, but you may have another numbering scheme for your observing run. The only restriction is that each of the IDs must be unique within a given user object file

Slew Telescope

If you are connected to an Autostar or LX2000 telescope, clicking on **Slew Telescope** moves you telescope until it points at the selected object or Starmap location.

Sync Telescope

If you have the object selected in the center of the eyepiece, clicking on **Sync Telescope** will align synchronize the telescope's pointing with the star map.

View Log

Clicking on **View Log** opens the observing database. The observing database allows you to keep track of your observations. Autostar Suite automatically fills in the record with information about your observations. The dialog below shows a typical observation record.

Buttons at the bottom of the record, let you scroll back and forth through your observations. If you desire to make hard copies of an observation the system will print a one page record, including your image to include in your observation journals. After you have saved and printed your observations, the *Clear All* button will erase the observation records so you can star a new session.

Show Image/Get DSS Image

If the **Show Image** button appears, it means that an image of the object is included in Autostar Suite's internal gallery. To look at the image, just click the button and a window will open with the image. The image can be closed by clicking on the **X** in the upper right of its frame.

If there is no image for the object in the internal image gallery, the button will read: **Get DSS Image**. If your computer is connected to the Internet, clicking on this button will cause Autostar Suite to access computers at the Space Telescope Science Institute (Hubble's control center). It will retrieve an image from STSCI's Digital Sky Survey and display it in a new window. The image can be closed by clicking on the **X** in the upper right of its frame.

Create Tour

Together the **Create New Tour** and **Add To Tour** buttons allows you to easily create and save tour for your Autostar telescope. Clicking on **Create New Tour** opens a dialog similar to the one shown below:

This dialog established the telescope for which the tour is being created. Meade LX200 and Autostar telescopes use text object descriptions for objects. The new ETX-LS family of telescope allow you the have both audio descriptions and images in your object descriptions. Once you have selected what kind of tour you are building. The program prompts for the tour name with a dialog similar to the one below:
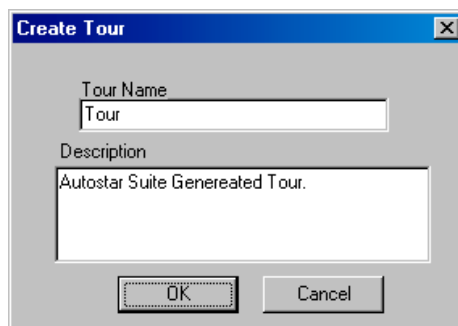
All you have to do, is proved a name for your tour, not to exceed 16 characters in length and a brief description of your tour.
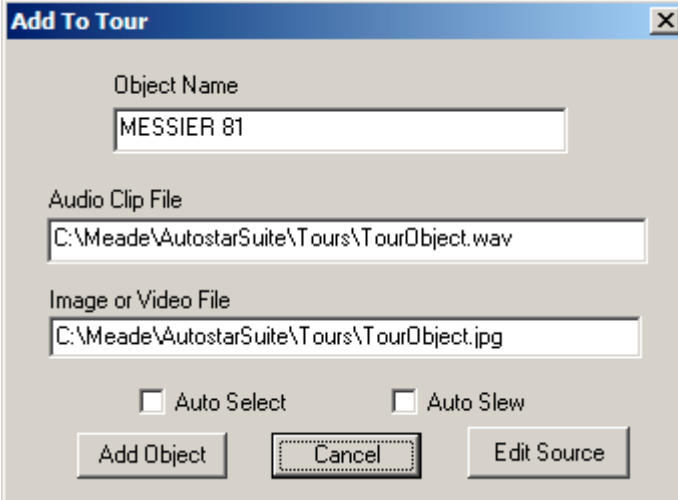
Add To Tour

Once you have created you tour, just point to object in the Sky Map and click to bring up the utilities menu and click the **Add To Tour** button and a dialog like the one below will appear
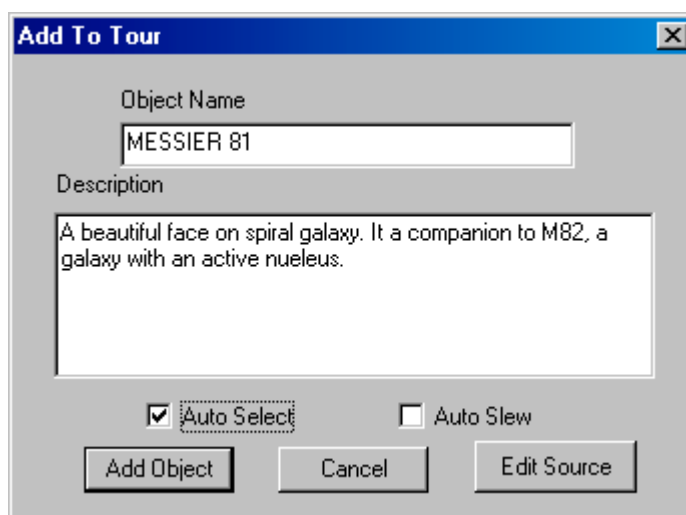
You can enter you own name and description for the object, or take the defaults supplied by the program. There are two check boxes below the description. Checking *Auto Select* will cause the tour to automatically display the object detail to the user. Checking *Auto Slew* causes the telescope to slew directly to the object without prompting the user.

Clicking on the *Add Object* will include the object in the current tour. Clicking on cancel will close the dialog without adding it to the tour. Clicking on *Edit Source*, allows you to actually inspect and modify the current tour that Autostar Suite is building.

If you are building a Tour for an ETX-LS telescope, the dialog will appear similar to the one below. In this example, you see that instead of typing a description, you can record your own description to a Windows .WAV format file and substitute it for the default description. Similarly, if you have your own .JPG image you want to include, you may supply it in lieu of the default.

Add To Tour

Object Name

MESSIER 81

Audio Clip File

C:\Meade\AutostarSuite\Tours\TourObject.wav

Image or Video File

C:\Meade\AutostarSuite\Tours\TourObject.jpg

☐ Auto Select   ☐ Auto Slew

Add Object   Cancel   Edit Source

7. Telescope

The **Telescope** menu contains a number of commands that allow you to link your telescope to Autostar Suite. Once linked, you can operate your telescope under remote computer control.

Protocol

There are four different ways to use Autostar Suite to communicate with and control you telescope. The protocol menu allows you to select how you want your PC to talk to your telescope and how your telescope can talk back to your PC.

Meade® Instruments has developed the Autostar family of computer controlled telescopes such that these unique instruments can automatically drive the telescope to any object contained in its own database, or to any specified R.A. and Dec. coordinate. The coordinates may be supplied either from the telescope's control handbox, through an RS-232 interface, via modem, via network, or via USB Serial connection on some models. Autostar Suite supports many of the telescope's commands, but uses the programs values for R.A. and Dec. instead of the telescope's internal database. This assures future compatibility as new databases become available.

WARNING: Use extreme caution when using the Autostar in the remote control mode. Autostar Suite cannot determine if there are any mechanical interference that may develop as the telescope is moved, such as, a camera extending to far from the back of the telescope. As a result, it is possible to move the telescope into positions that may cause serious damage to the equipment or personal physical injury!

None

Selecting this menu item disconnect the Starmap from the telescope if it is presently connected.

Autostar Via Serial Port

Selecting this option will attempt to connect the Starmap to you telescope via the currently selected serial port. Once connection is established, the many of the telescope commands in the menu will be enabled. The program will display a dialog box to inform you that the connection was successfully completed.

Via Modem

Autostar suite can also control a telescope that is connected remotely via a telephone modem. In order to communicate via modem, the Autostar telescope should be connected to the modem. The modem is connected to an incoming phone line. The modem must be configured to automatically answer incoming calls and to communicate with the telescope at 9600 bits per second. You will need to consult the manufacturer's literature to make configure these settings.

With the Autostar telescope attached to its modem, you can then use this setting to dial up and control your remote telescope. When you select this option you will be prompted by a dialog box like the one below to supply the phone number and dialing instructions to the computer's modem.
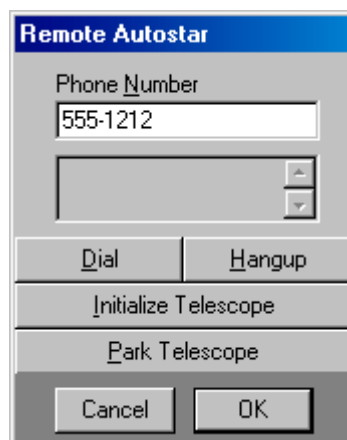
Via Network

Autostar suite can also control telescope remotely over a network connection. The connection may be a local area TCP/IP network, or over the internet. Thus, you can operate you instrument from across the room or from around the world. In order to con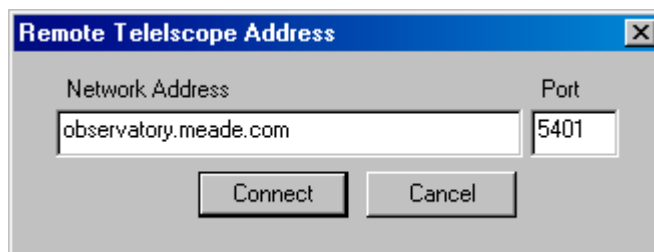nect to a network telescope, the telescope must be connected to another computer on the network and must be running the **Autostar Network Server** module (see section below).

When you select a network connection, the following dialog will appear:

Remote Telelscope Address

Network Address

observatory.meade.com

Port

5401

Connect   Cancel

You will need to enter the network or IP address of the computer running the Network Communications module and its IP port number. By default Autostar Suite uses port 5401. Unless your network administrator requires you to change this value, Meade recommends you leave this setting unchanged.

When network comminations is established, you will usually be prompted for a password to access the telescope. Whenever you put a telescope on a network, you must consider that some careless or malicious user may access your scope. A strong password is the best way to insure only trusted users can control the scope.

Telescope Access Control

Enter Password

OK   Cancel
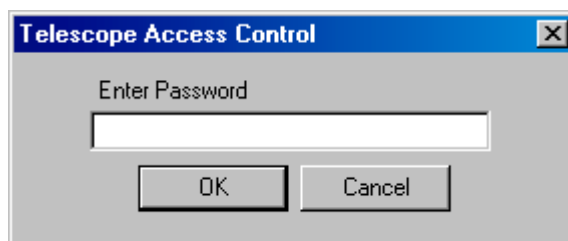
Enter the telescope password and click on OK. After a moment you will able to control the remote telescope from within the Autostar Suite.

A Single Machine Networks/Port Sharing

One of the benefits of network scope control is that it allows several modules to share a single serial connection to your telescope. Thus, with only a single serial cable, the Remote Handbox, Starmap, Envisage and Dome control modules can all access the telescope at once. The simplest way to achieve this benefit is to run the Network Communications Module on you computer and then use the **Autostar Via Network** protocol to access your telescope. Conceptually, you are running a single computer network.

Operationally, you first start the *Autostar Network Server* module, then select the *Autostar Via Network* protocol. When prompted for the *Network Address*, enter you Computer's name or the string "127.0.0.1". You can find your computer's name by pointing the "My Computer" icon on your screen and clicking the right mouse button. When the dialog appear, click on "Properties". Then select the tab that says "Computer Name" to find out your computer name.

Set Telescope Fields

The **Set Telescope Fields** command displays the current sizes of the fields of view of both the guide scope and main telescope. The fields may be either rectangular or circular; the sizes are degrees, minutes and seconds of arc. The displayed values would be updated as soon as the communication to the observatory was established. You may change these values as you wish to reflect your own equipment. The values are saved between sessions so that you can plan your observing run without being connected to the telescope.

The field sizes can be displayed as an overlay on the starmap by selecting the **Telescope Fields** entry in the Starmap, Options dialog box
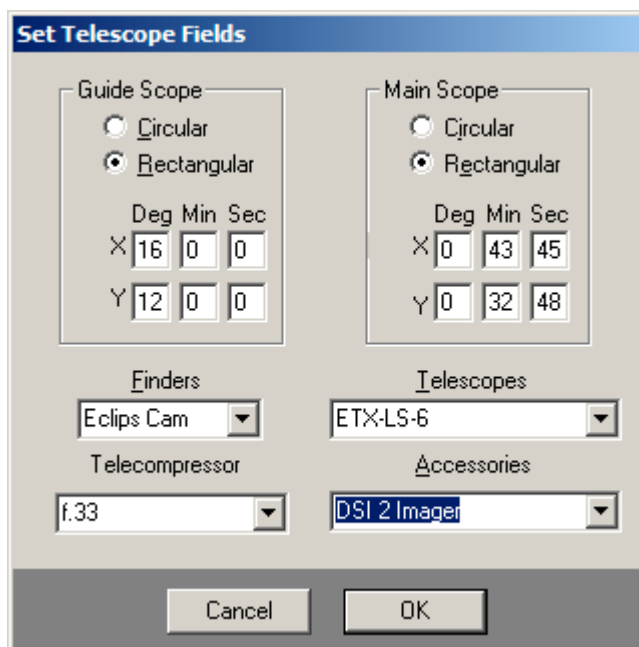
By selecting either **Circular** or **Rectangular** the display will change from an X/Y entry mode to diameter entry mode as appropriate.

Alternatively, you may directly enter the name of the eyepiece or accessory and its field of view into the appropriate fields.

Remote Handbox

The Remote Handbox module allows to access and exercise all of the functions of the Autostar Telescopes from your computer's desktop. When you select this menu item, a dialog box like the one below will appear. The dialog is composed of three main sections. On the left side of the dialog box is the Autostar menu tree. On the right side of the box is the virtual hand controller, complete with buttons and display. At the bottom of the display are the connection and speech controls.

Once the dialog is open, you must connect to the Autostar before you can use the Remote Handbox. Similar to the discussion above, there are two methods of connecting to the telescope. You can connect directly through the serial port, or via a network. If you connect via a serial port, no other module will be able to access that serial port, if you connect using the network method, several module may share the same serial port.

To connect, enter the serial port, or network address and port and then click on the appropriate check box. The display window will post and "Initializing…" message as it establishes contact with your Autostar. After a few seconds the menu tree will appear at the left and the Remote Handbox will be up and running.
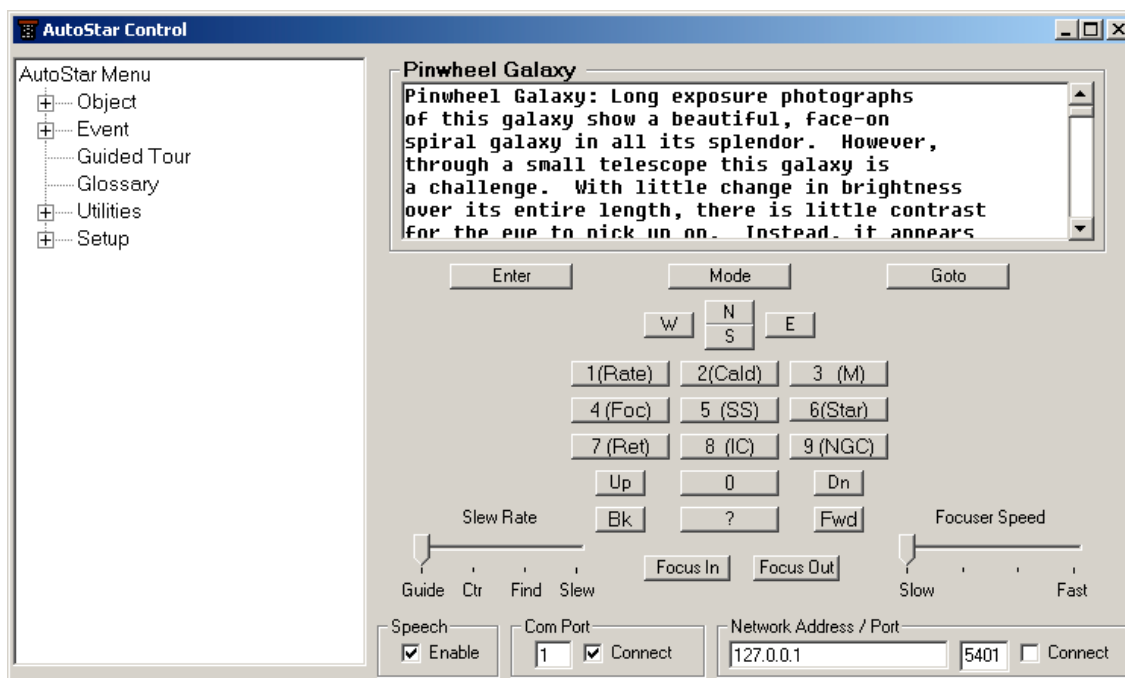
The Menu Tree at the left allows you to look at the entire Autostar menu at once. To access a particular function, all you need to do is click on the terminal menu item (menu items without a plus or minus next to them).   It is fast and saves a lot of keystrokes.

When the Autostar is requesting data, data can be entered from the PC keyboard. Additionally the PC arrow keys act like the scroll buttons on the keypad. The ENTER key on your PC keyboard acts as the ENTER key on the handbox. The ESC key on your keyboard will behave like the MODE key on the handbox. Alternatively, you can use you mouse on the virtual keys on the screen.

A Talking Telescope

If you check the Speech Enable box, everything displayed on your Autostar Handbox will be spoken by your PC's sound card. This is a great feature for tours and extended descriptions, you no longer need to take you eye out of the eyepiece to get an explanation of the object you are viewing.

Hand Control Panel

When you are connected to your telescope, the **Control Panel** menu items becomes active.   For legacy LX200 classics the control panel appears as shown below:
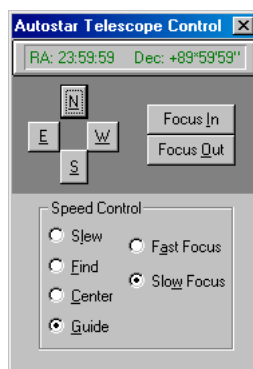
For the Autostar family of telescopes, the control panel is a completely functional remote handbox dialog that floats over the display. This handbox allows you access to virtually every feature of the telescope from the computer

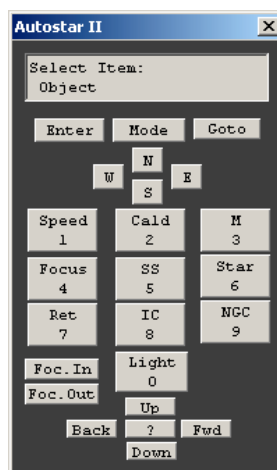desktop. Since it does not have the whole menu tree like Remote Handbox, it loads and run in a smaller footprint and much more quickly than Remote Handbox. Additionally, since it is integrated into the program, it handles port sharing automatically.

Scope Setup/Shutdown

Selecting the Scope Setup/Shutdown menu brings up the dialog below. This dialog allows you to remotely initialize or shut down your telescope.
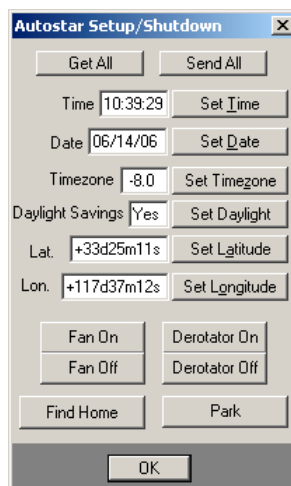
Initialization

When your telescope is initially powered on, it needs to have its Date, Time and Location information set before it will operate correctly. Additionally, you need to have corresponding information in Autostar Suite, so that the starmap will accurately reflect the current sky's appearance. The top two buttons on this menu make this simple.

Suppose you have a computer connected to a network that has accurate time and that you have initialized your location information in Autostar Suite. Then to quickly initialize you telescope, simply click ***Send All***. This will take all of the information from your computer and send it to your telescope. If you are going to be using this method all the time, it is probably best to disable the GPS on your telescope, if it is so equiped.

Alternatively, you may have a GPS equiped telescope in the field. Once the scope is aligned, the fastest way to set up Autostar Suite with all the necessary geographic and temporal information is simply to click ***Get All***. You will be warned that this process will update your PC's clock. Once you confirm this is ok, you are ready to go to work.

You can also send the individual setup commands to the telescope, on at a time, by clicking the button to the right of the parameter you wish to set.

When you hav finished initialization, simply click *OK* to dismiss this dialog.

Session Termination

The Scope Settings dialog is also useful for performing an orderly shutdown of your scope. At the end of your observing session, bring up the dialog and click on *Park Scope*. This will automatically issue the telescope park command, and disconnect the starmap, performing an orderly shutdown.

Auto Track

Selecting the Auto Track command, when connected to an Autostar telescope, toggles this feature. When this menu item is checked, the feature is enabled and causes the starmap to automatically change its display to keep the location to which the telescope is pointing on the display. It is a handy feature when you are using the handbox to control the telescope. To see what is in the sky in the vicinity of your scope, just consult the computer.

Communications

The communication menu allows you to configure and test communications between your computer and your Autostar telescope.

Start Network Server

This command starts the Network Server Module on your computer. When you start this module a dialog similar to the one below appears on you screen.
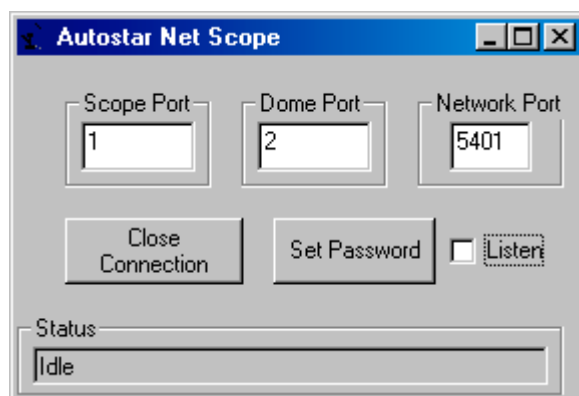

When this module is running, it allow network users to access and control your telescope. It can also be run locally to allow multiple modules on your own computer to share access to a single serial port telescope connection on your PC.

When initially started, the server is idle and will not accept a connection. To configure the server you sould first enter the serial port numbers into the windows. Enter the number of the port connected to the Autostar into the Scope Port field. If you have a Meade Observatory Controller, enter the serial port number of the the port connected to the observatory controller.

Before enabling connection you need to set a password. If you are only using the Network server as a port sharing mechanism, you and set the password to an empty string and then all connections will be accepted without prompting for a password. **This is dangerous is you are sharing the scope over a real network.** Meade recommends that you use a long password with both letters and numbers. Passwords are case sensitive.

Once you have configured the server, check the *Listen* box to begin accepting connections. When a connection is established the address of the current user is shown in the status bar as in the example below:
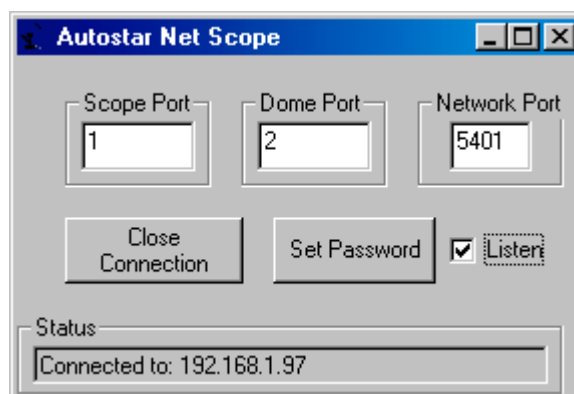
To terminate a connection you can uncheck the listen box. This will disconnect the current user. To accept other connections, recheck the Listen box. To terminate the server, click on the close connection button.

Be careful. The Network server is an independent task. It will continue to run after you exit the Autostar Suite. Be sure to close it separately at the end of your run.

Serial Port Setup

This command configures your computer's serial port to talk to either the Autostar directly or via modem. When selected it brings up the dialog below to allow you configure your serial port.
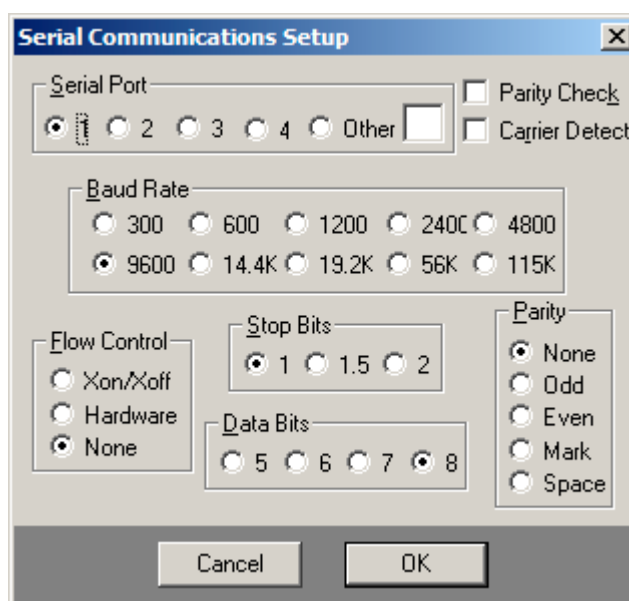
Normal settings for the serial port to talk to an Autostar or LX200 telescope are

Baud Rate	9600
Parity Check	Not Checked
Flow Control	None
Data Bits	8
Parity	None

When you have configured the settings for you scope or modem, click OK. These settings will be remembered the next time you run your scope.

If you are using a USB serial connection to your telescope, you will need to find out which serial port number has been assigned to you telescope. To do this, find the **My Computer** icon on your desk top.

Once you have located this icon, point to it with your mouse and click the **right** mouse button. A dialog similar to the one below will appear:
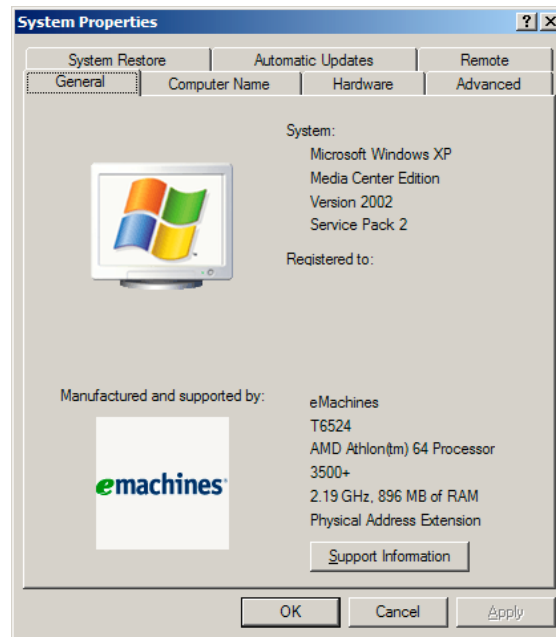
Using the regular left mouse button, click on the **Hardware** tap at the top of the dialog. The presentation should change to look similar to the one below:
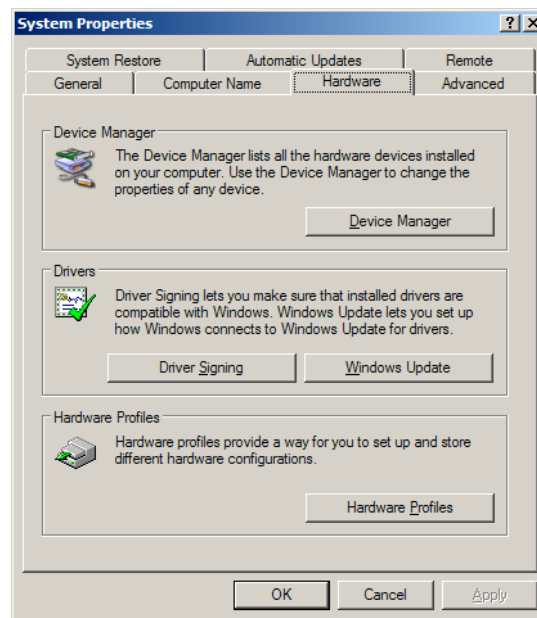
On this dialog, left click on the **Device Manager** button. The device manager, similar to the example below, will open on your display.
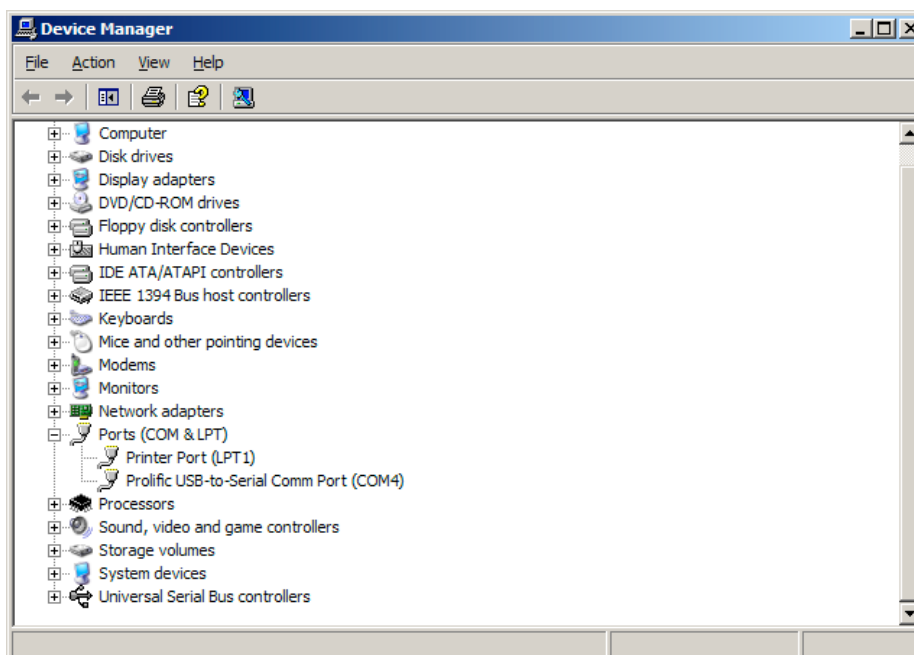
You will see the **Ports (COM & LPT)** item about half way down. Click on the "**+**" sign next to the entry. It will show you the available serial ports. The labels "USB Serial Port" or something similar is the port number you want. In the example above, you would use Serial Port 4.

Test Serial Port

This command allows you to send test strings over the serial port and see the responses to your commands. It is provided as an aid in configuring serial ports on your computer. When selescted the dialog below appears. When you have finished, you can close this dialog.
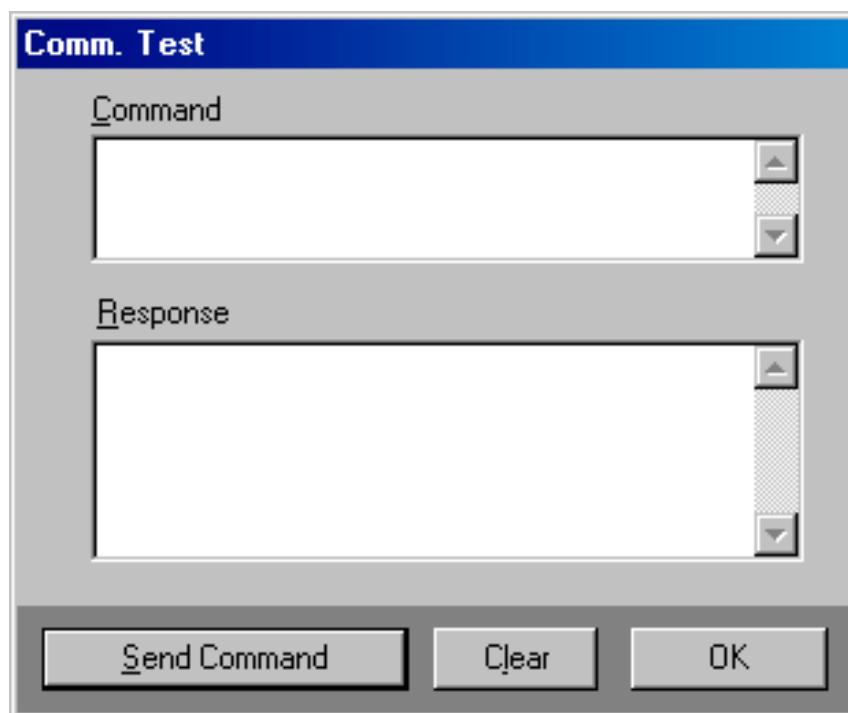
Enter you test command in the top window, and then click **Send Command** to transmit the string. Any responses will be shown in the window below. When completed, click OK.

Dome Control

Selecting this command starts the Observatory Control Module. When connected via serial port to the SSC's Autostar Observatory Controller. This program module allows you to control the roof or dome of your observatory, control auxiliary equipment and monitor key sensors in your observatory. The Observatory Control Module can connect directly to dome and telescope via serial ports on the PC, or may connect via a network to a remote telescope.   Once you have configured the connection you desire, check the appropriate box to connect to the Observatory Controller and Autostar telescope.

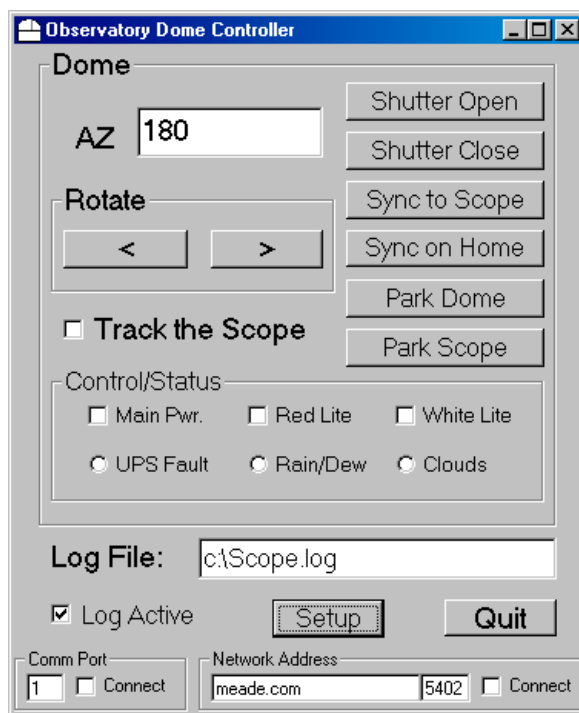In addition to controlling the observatory structure, the controller also keeps a running log of telescope pointing, air mass and auxiliary instrumentation in the Log File. The name and location of this file can be set from the main window.

For complete information configuration and operation of the Observatory Control Module, see the documentation for SSC's Observatory Controller Box. For details contact:

> Software Ssystems Consulting
> 615 S. El Camino Real
> San Clemente, CA 92672
> 949.498.5784
> www.ssccorp.com/DomeControl.html
> support@ssccorp.com

Update Autostar

Selecting this option starts the Autostar Updater Module. When you select this option, a menu similar to the one below will appear:
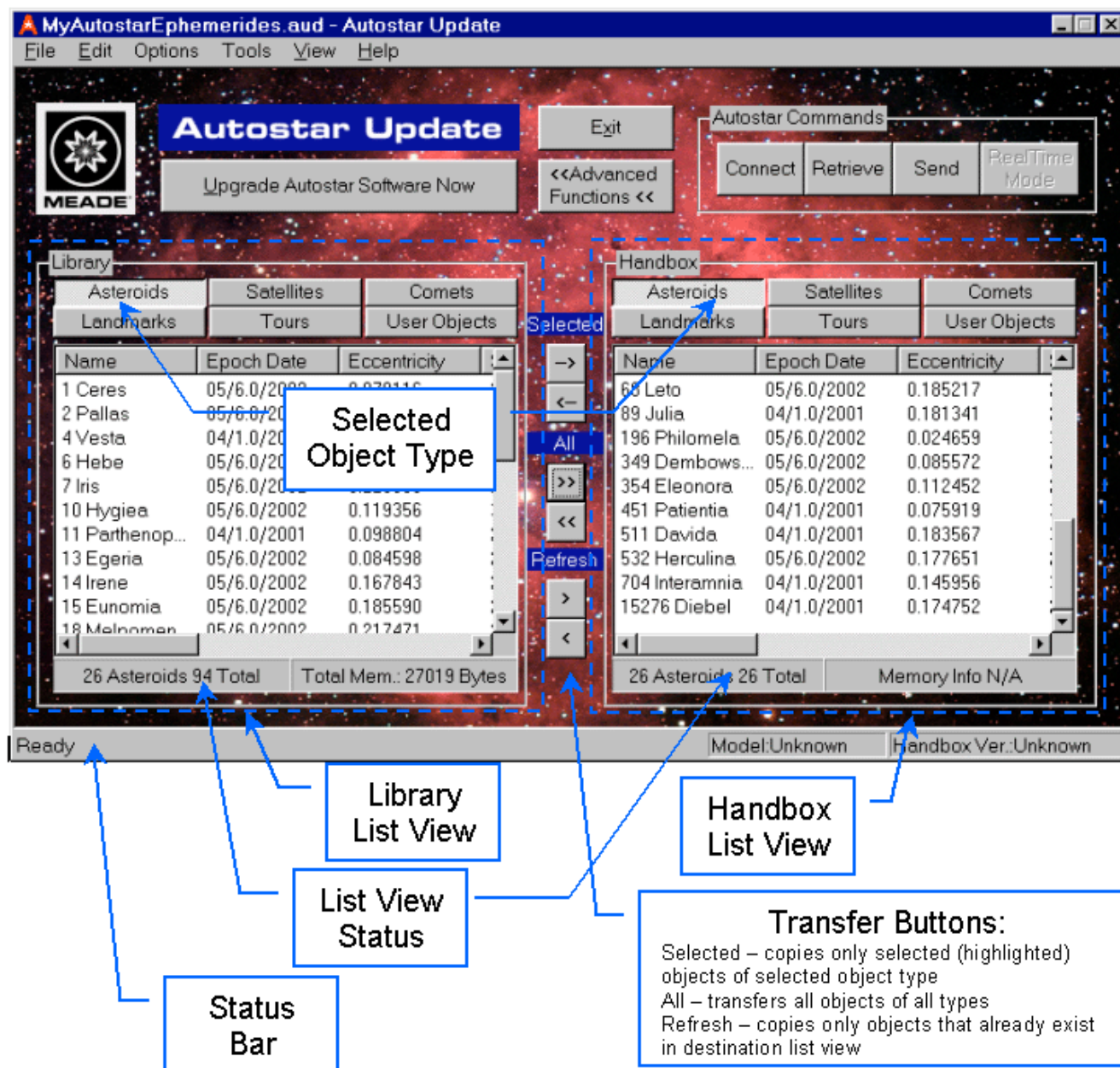
The Main Dialog Box offers the following buttons and features:

Upgrade Autostar Software Now	Upgrades the handbox software.
Advanced Functions	Toggles between "Basic" and "Advanced" view.
Autostar Commands	Commands for communicating with the handbox.
Transfer Buttons	Copies objects from one list view to the other.
Handbox List View	The list of objects contained in the handbox list.
Library List View	The list of objects contained in the library list.
Status Bar	Status and information.
List View Status	Status information about the Library List and the Handbox List View.
i	Exits Autostar Update.

Autostar Update performs two main functions:

1) Loads new software into the Autostar telescope
2) Transfers object menu choices such as comets, asteroids and user objects between your Autostar telescope and your PC.

Before you can perform either of these functions, your Autostar telescope must be properly connected to your Personal Computer. To connect your telescope to your computer you will need an interface cable. Normally, a set of compatible cables are provided with your Autostar Suite.

Depending on the type of Autostar Handbox and Telescope, you will need to use one of three different optional Cable Connector Sets. Contact your local dealer or Meade Instruments Customer Service for information about purchasing one.

#505 Connector Cable Kit – for use with

Handbox	Telescope
#495 Autostar	All DS Models
	All DS-2000 Models
	ETX-60 / 70
#497 (ETX) Autostar	All DS Models
	All DS-2000 Models
	All ETX Models
	LX-90

#506 Connector Cable Kit – for use with

Handbox	Telescope
#494 Autostar	All DS Models
	All DS-2000 Models
	ETX-60 / 70

P/N 07047 LX200 Interface Cable – for use with

Handbox	Telescope
Autostar II	All LX200 GPS Models
	All LX200R Models
	All RCX400 Models
	Max Mount

If you lack cables may purchase the optional LX200 Interface Cable, #505 Connector Kit or #506 Connector Kit. Follow the instruction sheet that came with the connector kit to fully utilize the software. The Autostar Update can be used without connecting the Autostar telescope to the PC, but you will be limited to manipulating the data on the PC only.

Loading new software into your Meade Autostar Telescope

The Autostar Update document window opens in the basic view. If all you wish to do is update the software in your telescope to the latest revision, connect your computer to the internet, connect your Autostar telescope to your PC, and click on the *Upgrade Autostar Software* Now button.

Autostar Update then automatically checks the latest version of the software found on Meade's Web Site (if you are connected to the internet), also checks your local hard disk to see if a version is already stored there, and finally checks your telescope. The versions of the software that were found then display in a dialog box, including the revision level of the software in your telescope. Follow the prompts in the dialog boxes to complete the operation. Note that transferring this data to your telescope takes approximately 15 - 25 minutes. Caution: Do not disturb the telescope during this operation.

Transferring objects between the Autostar telescope and your Personal Computer

To select this function, click on the Advanced View button. The window expands to show the *Autostar Commands* buttons, the *Library List View* and the *Handbox List View*. The Library List View displays a list of objects that are currently in Autostar Update's memory. Use this list view to manipulate, sort and edit objects prior to transferring them to the Autostar telescope. The Handbox List View displays a virtual list of objects contained in the Autostar telescope. Build this list by transferring desired objects from the Library List View. Hint: Sort and select the objects you wish to transfer to the Autostar telescope for your next observing session.

How To Retrieve The Objects Stored In The Handbox

When you first launch Autostar Update, the right List View Window, representing the handbox data, will be empty. This window is a temporary storage place for building and organizing your handbox data list. Note: Once you click on the Send Data button, the contents of this window OVERWRITES the current objects contained in your handbox. Therefore, you may wish to retrieve the handbox data first, and then add to, edit, re-arrange and/or save that data before overwriting it.

To retrieve the asteroids, comets, satellites, landmarks, user objects and tours that are currently stored in the handbox:

1. Connect the Handbox to the PC using the appropriate cable kit.

2. Turn the telescope power on.

3. Click on the Retrieve Data button in the Autostar Commands button group located in the upper right of the Advanced View window. It may take several minutes to retrieve the data, depending on how much data is in the handbox. Once the data is retrieved, it is automatically saved to a backup file, so you can undo any changes you make before clicking on the Send Data button by choosing the File Menu Item Restore Data….

How To Transfer Objects To And From The Handbox And Library Collection

To select this function, you must be in Advanced View mode. The Advanced View window displays the Library List View on the left and the Handbox List View on the right.

The Library List View contains the master list of objects Loaded or Imported from your local hard disk. The Handbox List View contains the data that will be Sent to the Autostar Handbox, or that have just been Retrieved from the Autostar Handbox.

To transfer objects from one List View to the other:
1. Select the appropriate object type by pressing one of the 6 buttons (Asteroids, Satellites, Comets, etc.) at the top of either list. Pressing one button from either list changes the displayed object type in BOTH lists. Note: All data types are stored in the Autostar Update program at all times, but the list view only displays one object type at a time.

2. Select the objects from one list view that you wish to copy to the other list view. You may select one at a time by clicking on an object with the mouse, or you may select multiple objects by holding down the shift key or CTRL key. You may only select objects of the same type, however.

3. Either drag the selected items from one list view to the other by holding down the mouse button and releasing it when the objects are over the destination list view, OR click on the Copy ObjectsButton (labeled with a "->" or "<-" arrow).

Note: Any objects copied to the Handbox List View are not yet in the handbox. You may sort the list by clicking on the desired column heading, edit objects, delete objects, or create new objects.

When the Handbox List View contains all the objects you wish to transfer to the handbox:

1. Connect the Handbox to the PC using the appropriate cable kit.

2. Turn the telescope power on.

3. Click on the Send Data button in the Autostar Commands button group located in the upper right of the window. It may take several minutes to send the data, depending on how much data is being transferred. Once the data is sent, it is automatically saved to a backup file, so you can undo any changes you by choosing the File Menu Item Restore Data.

Caution: Sending data to the handbox erases all the objects already in the handbox, so if you do not wish to permanently lose this data, Retrieve it first, Save it to the hard disk, and then proceed as above.

How To Import Satellite, Comet, Asteroid And Tour Data

Objects such as Satellites, Comets, Asteroids and Tours may be loaded into the Library List View from sources other than standard Autostar Update Data (*.aud) files. You may find these additional data from many sources on the World Wide Web, including Meade Instruments Web Site. The following are file types that can be imported into the Autostar Update:

*.txt   Any object may be imported as a Text file.
*.tle   Satellite data may be imported as a TLE file
*.rom   Any object may be imported as a ROM file
*.mtf   Tour data may be imported as an MTF file

To import any of the above files, choose the Import command from the File Menu, or drag the file from your Windows desktop to the destination list view in the program. Note: If Real Time Mode is activated, the drop destination is limited to the Library List View.

Two options are available during an import operation:

1) Delete all existing objects first – when checked, this option will delete all objects of the selected type from the destination list view first. Only the newly-imported objects will remain after this operation. If this option is not checked, new objects will be added to the existing list, but will not overwrite any objects of the same name.

2) Only import objects that already exist – when checked, this option will compare each imported object to each object in the destination list view. If a match is found (based on the name), the object will be imported and overwrite the existing object. If not match is found, the object will not be imported. This is a useful option for updating the data in existing objects without adding or deleting any objects.

How To Use The Safe-Loader To Restore A Damaged Handbox

If you encounter any problems while upgrading the software in your handbox, the flash memory in your handbox or telescope may become damaged, rendering the system non-functional (e.g., the handbox does not display anything when powered on, displays garbage characters, etc.). This typically occurs if an upgrade command is interrupted in any way before completion.

Fortunately there is an easy way to restore the damaged flash memory: Connect the handbox to the telescope and the PC with the telescope power off.

For a #495 or #497 Autostar, simultaneously hold down the "ENTER" and the Scroll Down key, (Hint: Do not confuse with the Down Arrow key) and turn the telescope power on while holding these keys. The handbox displays "FLASH LOAD – READY" to indicate that you may now transfer data to and from the handbox.

For an Autostar II, press the "9" button three times immediately AFTER applying power to the handbox. The handbox displays "Downloading… DO NOT POWER OFF" to indicate that you may now transfer data to and from the handbox. NOTE THAT THE AUTOSTAR II DEFAULTS TO 9600 BAUD IN SAFE MODE. This is the best transmission speed to ensure reliable data transfer. However, if you wish to increase the speed, click the Connect button first, then Options-> Max Baud Rate.

Click on the Upgrade Autostar Software Now button to transfer the latest software to the handbox and repair the damage. Note: The "Erase User Banks" check box is available for the Autostar II only. This option will erase all user information, including site information, owner information, user objects, telescope calibrations, etc. Do not use this option unless you are having severe problems uploading your handbox.

All other Autostar Update functions work normally in this mode (e.g., you can save user downloads, etc.).

How To Create Custom User Catalogs (Autostar II Only)

Before creating a Custom User Catalog, consider carefully the data that will be stored in that object. Each catalog can have 6 user-defined fields of 15 characters total, including the field name and data. For example, a field labeled "FIELDNAME" may have the data "123456" contained within it. The data is stored and displayed as pure character data, so decimal points are counted as a character, and any combination of letters and numbers and other characters may be used. For example, the above field may contain "123.4%". Of course, there is no minimum requirement except that the label is at least one character, so FieldName: "1" with data "" is acceptable. There are 3 characters that are not allowed in either field names or data. These are ':', '#', and ','.

Custom User Catalogs may only be created from within the Autostar Update software. To do so, select an empty Custom User Object by right-clicking on the User Object type button in either list view. Empty catalogs are given a default name of "UndefinedX", where "X" is a sequential number between 1 and 20. Within the list view window, right-click to display the list view context menu. Select "new" from this menu to display the "Define New User Catalog" Dialog Box.

Within the dialog box, enter a name for this Catalog, and define up to 6 new fields by typing each field's name in "Field Name:". As the name is typed, the number of characters available for data is displayed. The longer the field name, the shorter the data must be. Click "Add" to add each new field. When the catalog has been defined, click "OK" to proceed.

The "Autostar Update Object Editor" Dialog Box will now be displayed so object data may be entered. Note that there must be at least one object in a catalog, or its definition will be lost. To delete a custom catalog, simply delete all objects within that catalog.

How To Manage Custom User Catalogs (Autostar II Only)

To transfer Custom User Objects from the Library List View to the Handbox List View or vice-versa, use the Transfer Buttons on the main dialog box in much the same way as they would be used with normal User Objects. However, due to potential variations between the source and destination catalog definitions, the following rules apply:

- Even though catalogs may be given original names, they still maintain their numerical identities. For example, a catalog that had a default name of "Undefined13" before being defined will be treated as the 13th Custom Catalog. Thus, when either User Object type button is clicked, the 13th Custom Catalog will be displayed in both list views even if it is not defined identically in both list views.

- If the source and destination list views have identical definitions of the catalog displayed, the "Transfer Selected" and "Transfer Refresh" buttons will work normally.

- If the source list view catalog has been defined but the corresponding destination catalog is empty, the "Transfer Selected" buttons will create the catalog definition in the destination list before copying the objects, whereas the "Transfer Refresh" buttons will have no effect.

- If the source list view catalog has a different definition than the destination catalog, neither the "Transfer Selected" and "Transfer Refresh" buttons will function.

- Regardless of the definitions of the destination list view catalogs, the "Transfer All" buttons will first erase all destination objects, then copy the source objects. Note that selecting "User Objects" in the "Confirm Object Replace" dialog will transfer ALL 20 Custom User Catalogs plus the normal User Objects.

- The above rules apply to Real Time Mode as well..

MySKY Update Tool

The mySKY update tool will allow you write software updates to your mySKY SD memory card. To update your card, remove it from mySKY by pressing the card in and then releasing it. The card will be released from the socket and then can be removed from the unit. Insert the SD Card into your computer's SD card reader and then click on the Update mySKY menu entry. If you are connected to the internet, you may see a dialog message similar to the one below:
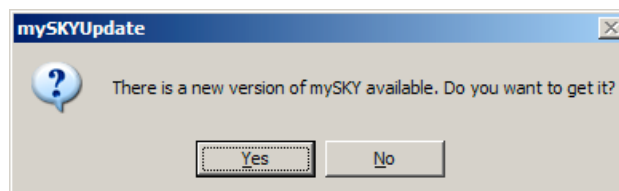
This indicated that a new version of the software is available from Meade. By click on "yes" you will start the download of new firmware. Downloads will vary in size, you can see the progress of the donload on the main module dialog The moudle dialog similar to the one below will appear when downloading begins, or if downloading is skipped.
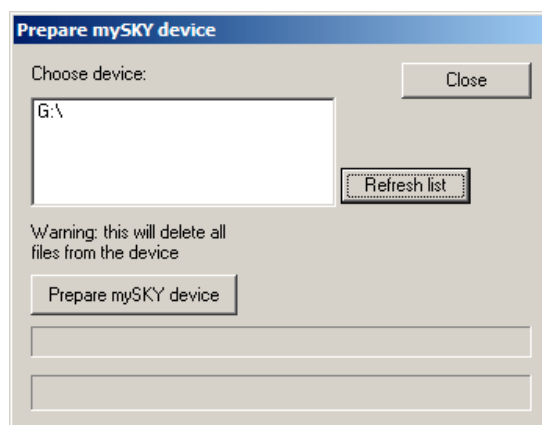

After downloading has completed, click on the drive letter corresponding to the SD card reader on your system that is shown in the "Choose device" window. If you had not inserted your SD card before the module started you may need to click on the "Refresh List" button to make your SD drive appear in the window. Then, simply clock on "Prepare mySKY device: button and the module will prepare your SD card for you.

PEC Tool

The PEC Utility Tool allows you greater control over the Periodic Error Correction functions of your LX200GPS, LX200R, RCX400 or Max Mount telescope.

During PEC Training, small corrections made to keep a star precisely centered by a DSI, LPI or via hand controller inputs, are recorded and remembered by your telescope so that they may be automatically replayed by the SmartDrive™ system. After you have performed the PEC training procedure, the PEC Tool allows you to further refine the PE corrections made by SmartDrive.

PEC Utility option is located in the AutoStar Suite telescope menu. When you select this menu item, the PEC Tool module will start and you will se a menu similar to the one shown below.
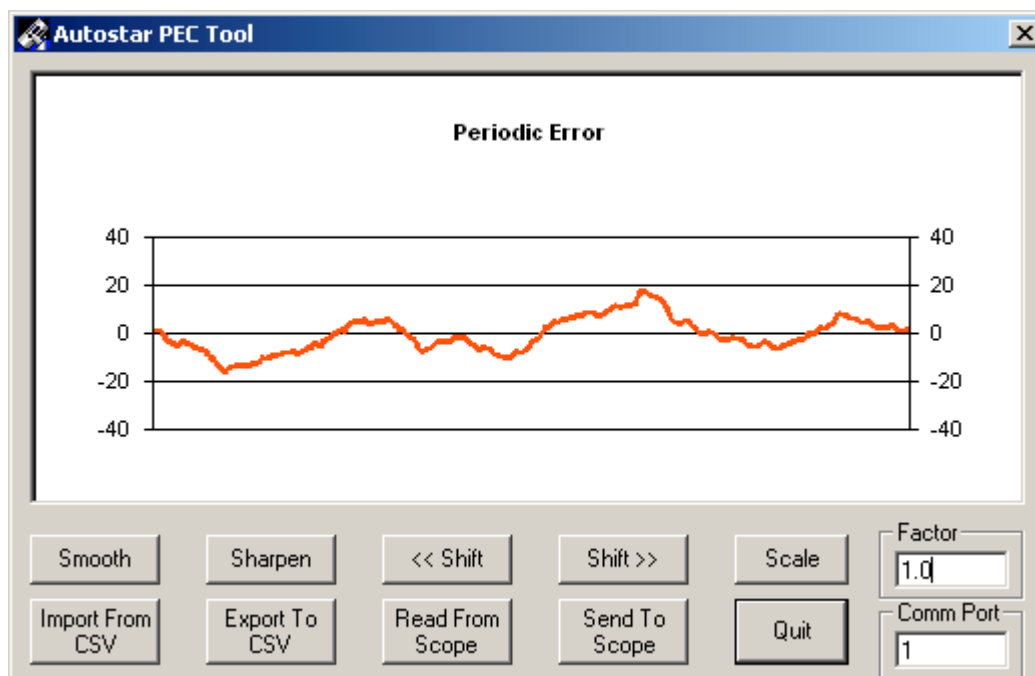
Functions of the Buttons

During Periodic Error Correction, you will move the Autostar Arrow keys to keep a star centered in the crosshairs of a reticle eyepiece. After you have performed the PEC procedure, the PEC Utility tool allows to further tweak the corrections you have just made. The buttons and fields on the PEC Tool menu have the following functions:

Comm Port: Connect the telescope to your PC using the supplied RS232 cable. Connect one end to one of your PC's serial ports and the other end to the RS232 port of your telescope's computer control panel. Enter the Comm port you have chosen in the Comm Port field.

Read from Scope: Press this button as the first step in the PEC Utility procedure. It reads the PEC data currently in your telescope and presents this information in an intuitive onscreen graph.

Sharpening: The sharpening function makes the corrections you made with the Arrow keys be applied more aggressively while chasing small variations in the tracking.

Smoothing: The smoothing function makes the corrections you made with the Arrow keys be applied less aggressively while chasing small variations in tracking.

Scale: Smoothing tends to reduce the overall magnitude of the correction, so it may be useful to select the scale function to re-enlarge the correction magnitude after smoothing.

Sharpening on the other hand, tends to increase the magnitude of the corrections applied. It may be useful to select the scale function to slightly reduce the correction magnitude after sharpening.

Before smoothing or sharpening, take note of the highest peak value on the graph. After you finish smoothing or sharpening, enter a number in the Fatcor box to rescale the graph back up to its highest peak. Hint: Enter a number between 1 and 2; e.g., 1.2.

Shifting the PEC: While using the Autostar handbox, you applied corrections with the Arrow keys after deviations were observed. That is, you would see a deviation and then correct it, a little late due to the lag between seeing and reacting by pushing an Arrow key.

The "Shifting the PEC" now allows you to shift the corrections forwards or backwards to compensate for the time lag. Press the Right Bracket to move the corrections forward or the Left Bracket to move the corrections backwards. Import from/Export to CSV: This allows you to import or export the PEC data to or from an Excel file. You may manipulate the data inside the Excel file, if so desired, and send it back to the PEC Utility.

This is also an excellent way to save your corrections for future sessions. Save the file in an Excel format for future reference.

Send to Scope: Press this button as the last step in the PEC Utility procedure. This step sends the new PEC corrections that you have just made back to your telescope.

8. Image

The Imaging menu allows you to control all of Meades astronimcal imaging cameras from within the Autostar Suite.
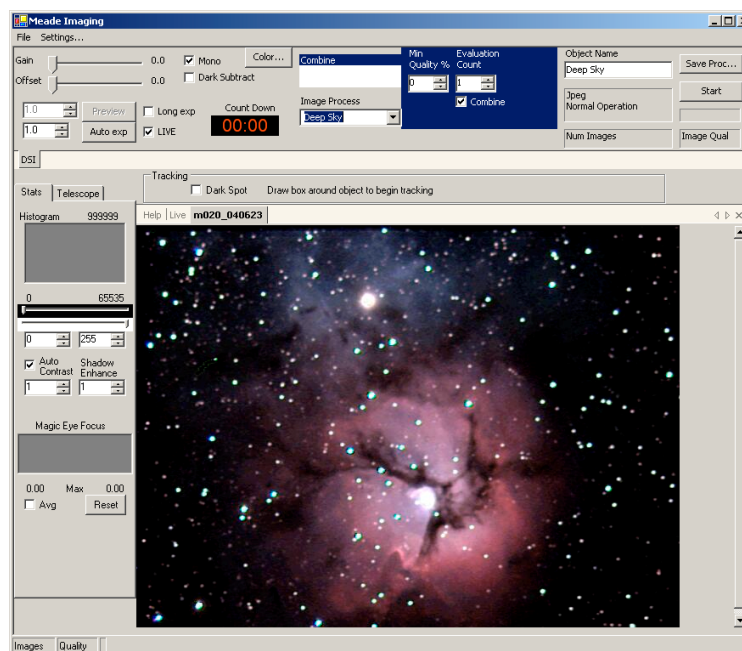
LPI Imaging

Selecting this command brings up the Envisage Package for the LPI. When clicked a dialog like the one below appears.
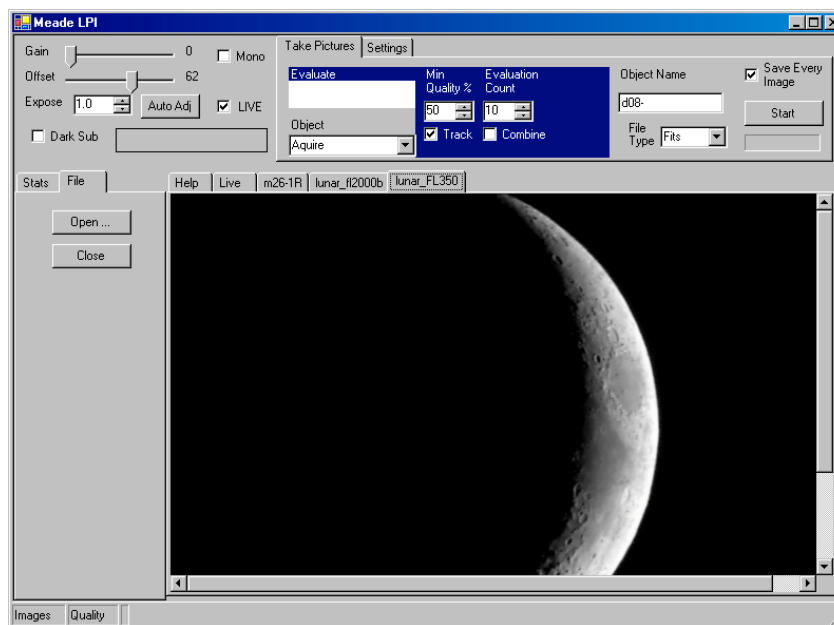
For complete details on the *LPI Imaging Module*, see its separate operating manual

DSI Imaging

Selecting this command brings up the Envisage Package for the DSI. When cliked a dialog like the one below appears:

For complete details on the *DSI Imaging Module*, see its separate operating manual.

Pictor Camera Imaging

Selecting this command brings up the Pictor View imaging module. When clicked a dialog like the one below appears.
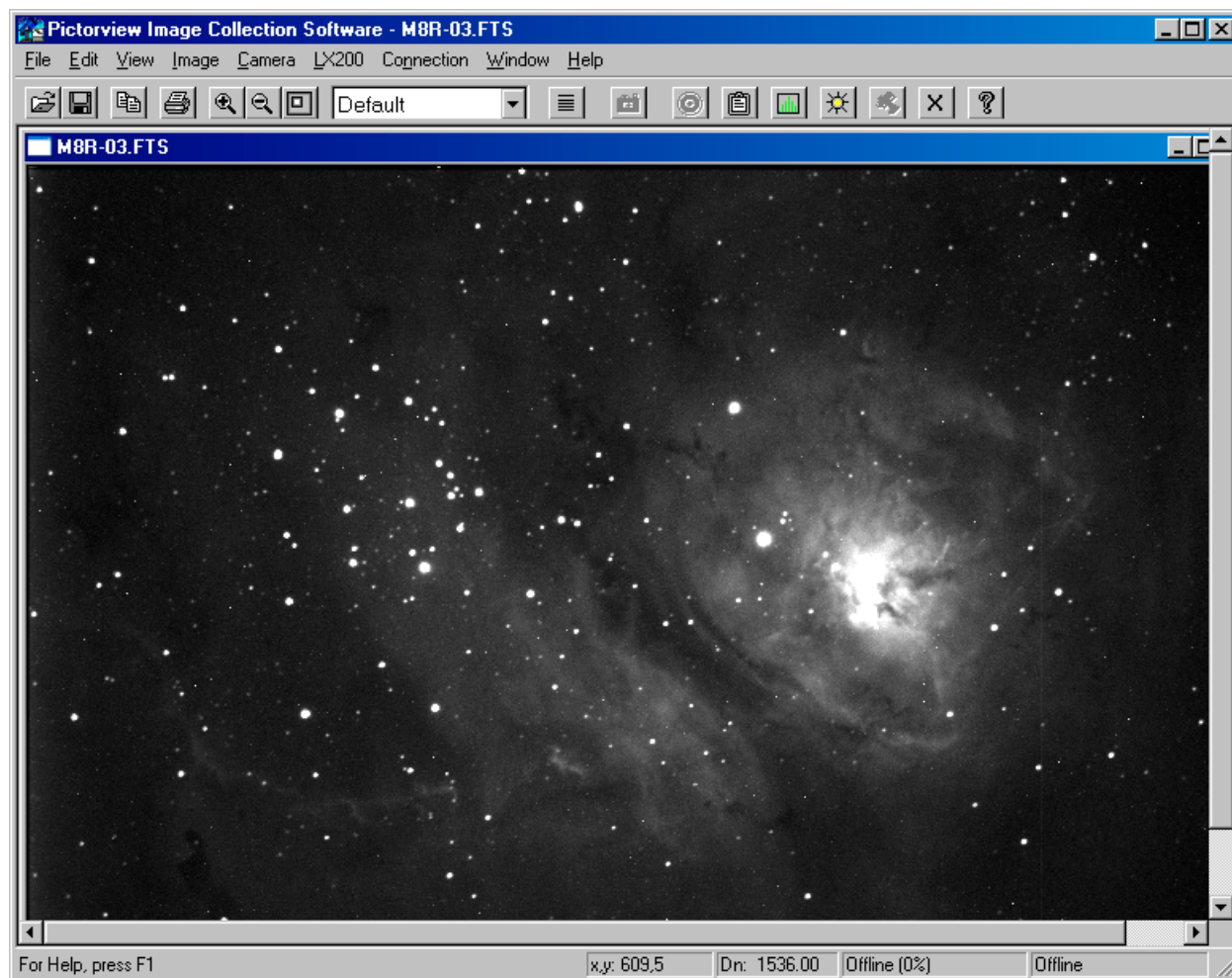
It will allow image with the entire line of Meade Pictor CCD Cameras. For complete operating instructions on this software, see the Pictorview Reference Manual.

Pictor Guiding

Selecting this command brings up the Pictor 200 Serial Autoguider module. When clicked a dialog like the one below appears.
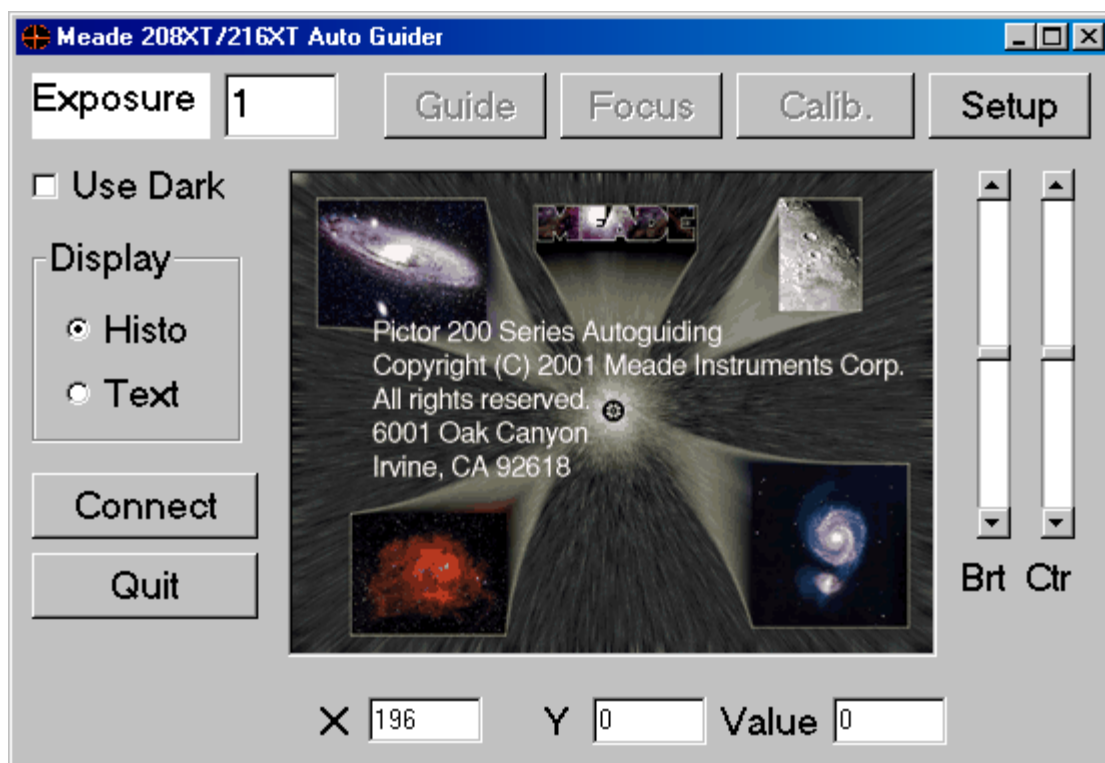
For detailed instruction on operating the Pictor Autoguider, see the Auto Guider manual.

DSLR Control

Selecting this menu item starts activates the *Autostar DSLR Control* module. This module is a allows you control popular DSLR camera that are equipped with serially controlled cable releases. The module opens a dialog similar to the one shown below:

The first step is to select the serial port that controls you camera in the "Port" window. Then you can test the control by clicking on the "Shutter" button. If the system is configured correctly, the camera should take a picture.

The "Shutter" button works just like the shutter button on your camera. Every time you press the mouse button while the mouse cursor is over the button, the shutter is activated. If the camera is in bulb mode, the shutter will stat open until you release the mouse button.

The "Bulb" button toggles the shutter. The first time you click on the Bulb button the shutter is depressed. The next time you click on the button the shutter will be released. The status of the shutter is displayed in the shutter window in

the upper right of the display. When an exposure is in progress the exposure time is shown in the Exposure frame on the bottom of the display.

If you camera support mirror locking and is configured with Mirror Locking enabled, you should click the "Mirror Lock" check box. This will insure proper operation of your camera.

The DSLR control allows you to program the camera to make multiple exposures. To make an automated series of exposures, enter the desired exposure time in seconds into the "Exposure Time" field.

Enter the amount of time you wish to wait between frames in the "Interframe Delay" field. You need to leave enough time between exposure to allow you camera to save the previous image and to allow a time for the electronics in the camera to cool down so that you do not cause the camera to produce noisy images because the sensor becomes to hot. The Interframe delay is expressed in seconds.

Finally, enter the number of frames you wish expose into the "Exposure Count" field. Then, click on "RUN" and the control will start taking images for you. The "Run" button will change to "Stop" and you can click on it to interrupt a sequence of images before they complete.   The status of your image sequence will be displayed in the "Exposure" frame at the bottom of the display.

Image Processing

Selecting this menu item starts activates the *Autostar Image Processing* module. This module is a comprehensive tool for the post processing of astronomical and scientific images, and the pre-press preparation of astro images.
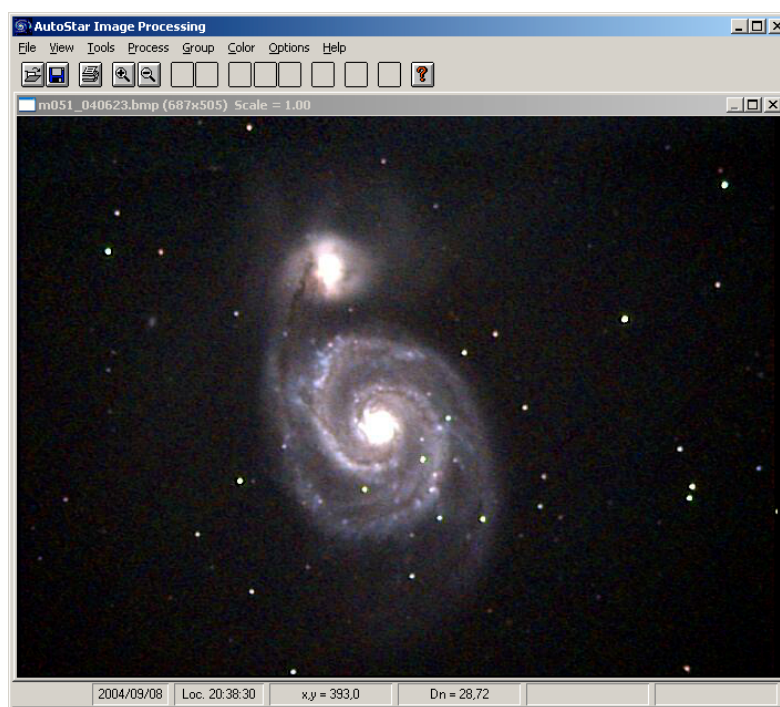
For complete details on the *AutostarImage Processing Module*, see its separate operating manual.

9. Options

The **Options** menu contains a variety of commands that are useful in setting up or optimizing your display for the current task at hand.

Night Vision

The **Night Vision** command changes all of the standard system colors to shades of red to help maintain your eyes adaptation to the dark. This is useful if you are using the program during actual observing session in the observatory or in the field. After selecting this option you should also lower the brightness on your monitor.

The status of the night vision option is saved from session to session, remember to turn it off when you are using the program in normal lighting.

Grayscale Palette
and Standard Palette

The **Grayscale Palette** and **Standard Palette** commands are used together to optimize your systems' ability to display gray scale images. If you are running in a standard VGA display mode, these commands will be enabled. Since these commands are not required in other display modes, they will appear disabled.

The standard VGA mode allows only 16 simultaneous colors, with this limitation in mind, Windows requires that these colors be set to the standards 'pure' colors, e.g. red, green, blue, magenta, etc., this provides only two gray values plus black and white. To improve you capability of viewing the high resolution B/W images, Autostar Suite re-programs the hardware registers on the VGA board to display 16 gray values instead of 16 'pure' colors. By selecting the standard 16 color palette in the **Image**, **Palette** menu when the Grayscale Palette is active, you will be able to view the images in 16 shades of gray

NOTE: The Grayscale Palette function removes all colors from the display leaving only shades of gray. Make sure you restore the regular colors by selecting the Standard Palette before you run other color intensive applications.

Starmap

The **Star Map Options** dialog box allows you to selectively enable a wide variety of features so that you can customize the Starmap display.
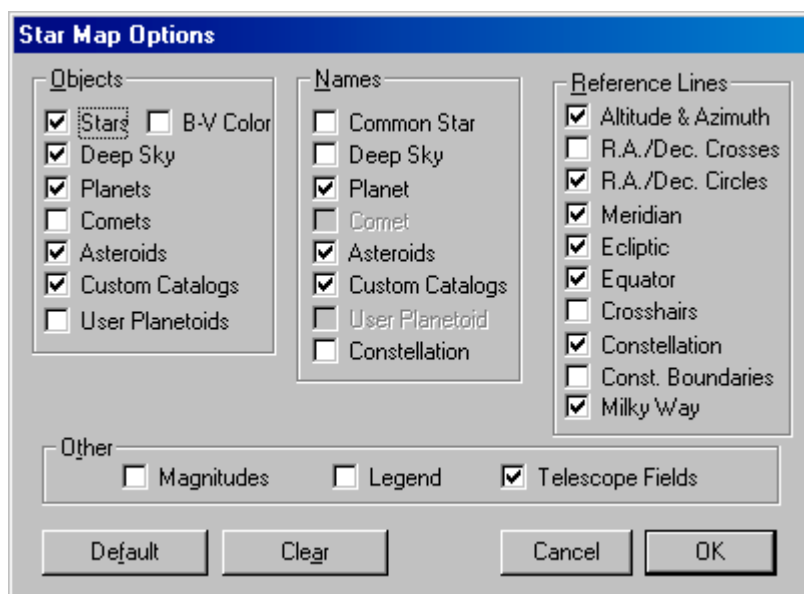
The **Names** option can only be enabled when the corresponding object has been selected. The constellation names and lines may be enabled independently if desired.

The **Default** button sets all of the options to their original default values, The **Clear** button removes all of the selections. This is useful when making major changes to the options.

When new objects are added, only the new items are redrawn on the existing starmap. If an existing item is removed, the entire starmap is redrawn.

Deep Sky

The Deep Sky Options dialog box allows you to select which classes of deep sky objects you wish to display. By checking each selection, you enable its display on the starmap.
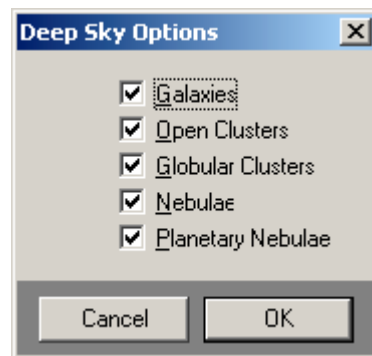

Lines

The Lines dialog box allows you to change the colors of the various lines used to draw the starmap. By altering the line colors you can customize the look of the starmap to suite your personal tastes.
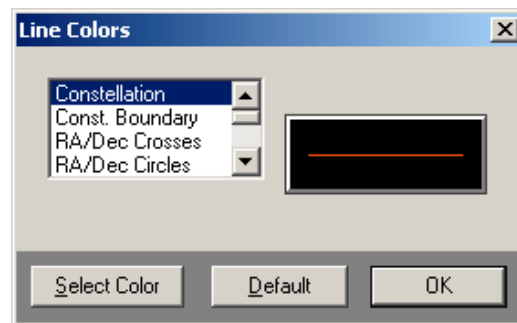
Names

The Font Selection dialog box allows you to select the size, color and font used to label various objects in your starmap. By altering fonts you can change the appearance of maps to suite you tastes
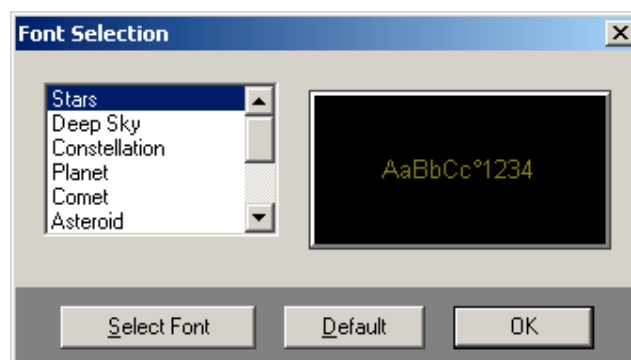
10. Help

The Help menu has two command. *About AutostarSuite* brings up a dialog that contains version and copyright information about the program. You should always check the version number and have it available prior to contacting customer support and reference it when checking for updates on the web. The dialog box should appear similar to the one below:


The other menu choice is *Help Index*, it will bring up the online help for the program. There you can view brief descriptions of all the program commands and the function.

Appendix A

Image Processing Basics

Image processing allows you to modify the appearance of an image by applying various types of filters, scaling options or transformations. The simplest type of processing is **linear scaling.** With linear scaling, one pixel from the source image is multiplied by a scale factor, then an offset term is added. The original pixel value is then replaced with the resulting value. This process is repeated on each pixel in the image.

The **contrast** and **brightness** of the image can be controlled by varying the scale factor (contrast) and the offset value (brightness). You should attempt to set the contrast to a value that allows the full range of the important parts of the image to fall on the sloping section of the transfer curve (see the **Scale Image** function), then set the brightness so that the minimum pixel values appear black or very dark gray. The following histogram and transfer graph illustrates the optimal contrast and brightness settings to give a normal view of the image.
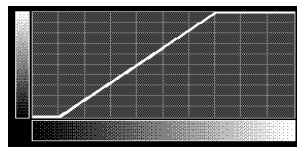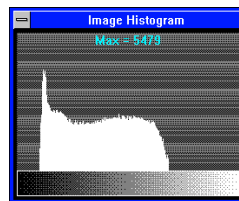
You may need to experiment to find the right settings for any given image. Sometimes it may be necessary to scale different areas of the image using different scaling factors. This can be accomplished by using a technique called **masking.** Masking allows you to separate various areas of an image based on a range of pixel values. Try the following example which illustrates masking:

        1. Load the VGR_IO_C.BMP image.
        2. Copy the image into Buffer B.
        3. Select the **Image, Scale** dialog box.
        4. Select **Linear** scaling if not already set.
        5. Move the **right** red slider to the third line from the left side of the graph. You should now see only the volcano portion of the image.
        6. Copy this image into Buffer A.
        7. Again bring up the scaling dialog box, then select the **Dynamic Scaling** option. The resulting image should now show the volcano with the desired contrast.
        8. Copy this image back into Buffer A.
        9. Select the **Merge Buffers** menu, then choose **A plus B**. This will add the volcano 'mask' to the original copy of the image. The resulting image will now show the planet detail with the enhanced volcano.

To be strictly accurate, you should also create a mask of the normal image which excludes the volcano area *before* copying the image into Buffer B. Try this on your own and compare the results.

Another useful image processing technique, **convolution,** allows you to enhance the appearance of an image by 'filtering' the image data by either smoothing (low-pass filter) or sharpening (high-pass filter) or combining parts of both types of filters.

This is accomplished by passing a convolution matrix, or kernel, over the entire image and replacing the center pixel in the resulting matrix with the scaled sum of all of the other values. For example, if you wanted to average each pixel with its adjacent neighbors the following kernel could be used.

1	1	1
1	**1**	1
1	1	1

Each pixel, including the center one, would be multiplied by 1, then the sum of each of these terms is calculated. The result is then divided by the sum of each of the kernel values, in this case 9. Finally, the center pixel value is replaced with the new result. This process is then repeated for every pixel in the image.

There are many different kernels that you can create that give various results. Autostar Suite provides several basic kernels that provide the most common functions, but feel free to experiment. There are a number of image processing books available that will describe other types of kernels.

Appendix B

Constants

Astronomical Unit	$= 1.4959787066 \times 10^{11}$ m
Parsec	$= 3.26$ ly
	$= 3.086 \times 10^{16}$ m
Light-year	$= 9.46 \times 10^{15}$ m
Gravitational Constant	$= 6.672 \times 10^{-11}$ m^3 kg^{-1} s^{-2}
Velocity of Light	$= 299792458$ m/s
Sidereal Year	$= 365.26$ days
Mass of the Earth	$= 5.98 \times 10^{24}$ kg
Radius of the Earth at the Equator	$= 6378.160$ km
Orbital Velocity of the Earth	$= 30$ km/sec
Mass of the Sun	$= 1.9891 \times 10^{30}$ kg
Radius of the Sun	$= 6.96 \times 10^5$ km
Luminosity of the Sun	$= 3.90 \times 10^{26}$ W
Effective Temperature of the Sun	$= 5780°$ K
Mass of the Moon	$= 7.35 \times 10^{22}$ kg
Radius of the Moon	$= 1738$ km
Radius of the Moon's Orbit	$= 3.84 \times 10^5$ km
Sidereal Month	$= 27.3$ days
Synodic month	$= 29.5$ days
Distance of the Sun from the center of the Galaxy	$= 8.5$ kpc
Velocity of the Sun about the Galactic Center	$= 220$ km/sec
Diameter of the Galaxy	$= 120$ kpc
Mass of the Galaxy	$= 7 \times 10^{11}$ solar masses

Bibliography

George O. Abell, *Abells Drama of the Universe*, Holt, Reinhart and Winston, 1978

Almanac For Computers 1990, Nautical Almanac Office, United States Naval Observatory, Washington, D.C., 1990

Astronomical Almanac, U.S. Government Printing Office, Washington, D.C., 1984, 1991, 1992

Jean Audouze and Guy Israel, Ed., *The Cambridge Atlas of Astronomy*, Press Syndicate of the University of Cambridge, 1988

J. Kelly Beatty and Andrew Chaikin, Ed., *The New Solar System*, Sky Publishing Corporation and Press Syndicate of the University of Cambridge, 1990

Dan Boulet Jr, *Methods of Orbit Determination*, Willmann-Bell, Inc., Richmond, Virginia, 1991

Pierre Bretagnon, Jean-Louis Simon, *Planetary Programs and Tables from -4000 to +2800*, Willman-Bell, Inc., Richmond, Virginia, 1986

Martin Harwit, National Air and Space Museum, Smithsonian Institution, *Astrophysical Concepts*, Springer-Verlag, New York, 1988

Alan Hirshfeld and Roger W. Sinnot, Ed., *Sky Catalogue 2000.0 Vol. I & II*, Sky Publishing Corporation, Cambridge, Massachusetts, 1985

Jean Meeus, *Astronomical Algorithms*, Willman-Bell, Inc., Richmond, Virginia 1991

Oliver Montenbruck, *Practical Ephemeris Calculations*, Springer-Verlag, Berlin, Germany, 1987

William K. Pratt, *Digital Image Processing*, second edition, John Wiley & Sons, Inc., New York, 1991

Roger Sinnot, Ed., *NGC 2000.0*, Sky Publishing Corporation, Cambridge, Massachusetts, 1988

W. Schlosser, T. Schmidt-Kaler, E.F. Milone, *Challenges of Astronomy*, Springer-Verlag, Berlin, Germany, 1991

Tirion, Rappaport, Lovi, *Uranometria 2000.0 Vol. I & II*, Willman-Bell, Inc., Richmond, Virginia, 1987, 1988

Michael Zeilik, Stephen A. Gregory, and Elske v. P. Smith, *Introductory Astromony and Astrophysics,* Saunders College Publishing HBJ, 1992

Glossary

absolute magnitude - the apparent magnitude an object would have if it were moved to a distance of 10 parsecs.

altitude - angular distance of an object above or below the horizon expressed in deg, min, sec. Positive values are above the horizon, negative values are below.

angular diameter - the apparent diameter of an object expressed in angular measure i.e., deg, min, sec.

aperture - the diameter of the objective lens or primary mirror of a telescope.

aphelion - the point on an object's orbit that is furthest from the sun.

apparent time - time by the real Sun, basically sundial time. Because the Earth's motion is not uniform, the accumulated error can be as much as 16 min.

apparent magnitude - the observed brightness of an object without any correction for distance.

asterism - a grouping of stars that have no association with each other, except that they appear to be associated.

asteroid - one of thousands of small bodies orbiting the Sun between the orbits of Mars and Jupiter, synonymous with Minor Planet.

astrometry - the branch of astronomy concerned with the precise measurement of positions and motions of celestial objects.

astronomical unit (AU) - 1.46×10^{11} meters, approximately the average Earth-Sun distance.

autumnal equinox - the point where the Sun crosses the celestial equator going from North to South. This occurs on approximately September 23.

azimuth - the angle along the celestial horizon intersecting the vertical circle (meridian) containing the object, it's measured from the South with positive to the West. This is contrary to the Geographical orientation which starts at North and increases to the East.

binary stars - two stars gravitationally bound about a common center of mass (barycentre).

blackbody - theoretically a body which absorbs all radiation that falls upon it and then re-emits it in its entirety. The intensity of the emitted radiation as a function of wavelength is solely dependent on it's temperature and is described by Plank's Law.

black hole - a theoretical body in which the escape velocity is equal to or greater than the speed of light.

B-V - see color index.

celestial equator - the projection of the Earth's equator onto the celestial sphere.

celestial poles - the two points about which the celestial sphere appears to rotate.

celestial sphere - an imaginary sphere with the Earth at it's center onto which all celestial objects are projected.

cepheid variables - stars having a long periodic variation in brightness.

chromatic aberration - an optical defect in which the colors are not all brought to the same focus resulting in unfocused color halos around the brighter objects.

color index - difference between two magnitudes measured in two different spectral regions. For example, B-V which is the difference between the B(blue) magnitude centered in the blue and the V(visible) magnitude, which corresponds to yellow-orange.

coma - an optical defect that affects only image details away from the center of the field of view causing stars to appear flared, like tiny comets pointing inward from the edge of the field.

comet - objects of small mass that orbit the Sun typically in highly elliptical orbits.

conjunction - time at which two objects appear closest together in the sky.

constellation - an arrangement of stars on the celestial sphere that resemble something familiar such as animals, people or objects. They are usually named after mythological beings, animals, ancient gods and heroes.

declination (DEC) - the angular distance North or South of the Celestial Equator and is measured in deg, min, sec..

ecliptic - apparent path of the Sun as projected on the Celestial Sphere.

ephemeris - tabulated data showing the positions or other calculated data of a celestial body for selected time intervals.

epoch - a fixed instant used as a reference point on a time scale i.e., B1900.0, B1950.0, J2000.0. This instant corresponds to the position of the vernal equinox on the first instant of the cited calendar year to which all precessional adjustments are applied.

equinoxes - the two points on the Celestial Sphere where the Ecliptic crosses the Celestial Equator.

focal length - the distance from the lens or mirror to the focal point.

focus - the point in an optical system where all the image components are brought together.

geocentric - coordinate system whose reference point is the center of the Earth.

great circle - the shortest distance between two points on a sphere.

greenwich mean time (G.M.T) - the mean solar time at Greenwich, England, which is located on the zero meridian.

heliocentric - coordinate system whose reference point is the center of the Sun.

hour-angle - the measurement from your meridian WESTWARD to the object in question.

julian date - time elapsed since 1 January 4713 B.C. Avoids the discontinuity in the day count at the beginning of each month.

light year - the distance that light travels in a year, equivalent to; 6.324×10^4 AU, .307 parsecs, 9.46×10^{15} meters

local mean time - specific use of mean solar time but adjusted for a particular location, it varies approximately 4 minutes per degree of longitude.

magnification - the process of increasing the apparent angular size of a celestial object.

minute of arc - 1/60 of one degree.

nadir - the point on the celestial sphere that is directly opposite the zenith and directly beneath the observer.

nebula - cloud of interstellar dust and gas.

nutation - a short period oscillation superimposed on the Earth's precession caused by the gravitational torques of the Sun and Moon.

obliquity of the ecliptic - the inclination of the plane of the ecliptic with respect to the celestial equator, currently it is approximately 23.5 degrees.

parsec - the distance from the Earth an object would have to be so that it's parallax would be one second of arc. One parsec is equivalent to approximately 3.26 LY.

perihelion - the point on an object's orbit that is nearest the Sun.

photometry - measurement of the intensity of light.

planet - any one of the presently known large bodies that orbit the Sun. From the Greek word for "wanderer".

precession - the wobbling of the Earth's axis caused mainly by the gravitational pull of the Moon and to a lesser extent the Sun, on the Earth's equatorial bulge. This causes the celestial equator to wobble, thus causing the precession of the equinoxes

precession of the equinoxes - the slow westward motion of the equinoxes along the ecliptic caused by the precession of the Earth's axis.

right ascension (RA) - the RA is the distance measured EASTWARD from the vernal equinox and is measured in hours, mins, sec.

second of arc - 1/3600 of one degree.

sidereal time - the hour angle of the vernal equinox, which turns out to be equivalent to the RA on your meridian.

topocentric - coordinate system whose reference point is the observer's location on the Earth's surface.

universal time - equivalent to Greenwich Mean Time (GMT).

vernal equinox - the point on the celestial sphere where the Sun crosses the celestial equator going from South to North, this point is also defined as the fundamental direction. The vernal equinox occurs on approximately March 21. It's corresponding point on the opposite side of the celestial sphere is the Autumnal Equinox.

zenith - the point on the celestial sphere that is directly above the observer.

Index